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AN ECOLOGICAL CROSS SECTION OF THE MISSISSIPPI RIVER IN THE REGION OF ST. LOUIS, MISSOURI.*

BY HENRI HUS.

INTRODUCTION.

The diversity of physiographic conditions afforded by a great river like the Mississippi always offers an incentive to a study of the distribution of the vegetation about it. This is particularly true of the Mississippi in the region of St. Louis, Mo. Here it traverses a valley from four to eight miles broad of which a portion, approximately one mile in width, is occupied by the stream. The greater part of its alluvial flood plain lies in Illinois, there forming the most northern portion of the American Bottom. This flood plain is modified by numerous agents either natural or artificial. Bodies of water, varied in extent, occupy a large area. While some of them are connected with the river at all times, others are so only in times of flood. Creeks, descending from the plateau, cut their way to the Mississippi. The land itself is high or low, sandy or clayey. Portions of it have been diked. Wooded tracts have been denuded for agricultural purposes. The resulting diversity of vegetation finds a parallel in that of the plateaus of Missouri and Illinois, both originally forming part of the same peneplain. These plateaus have been modified by various physical agents. Water is responsible for the formation of ravines and sinkholes. Under the influence of man large portions of the original forest have disappeared. Farms now occupy their place. Naturally these influences have gone far to modify the original vegetation. Contemporaneous with the recession, or even disappearance, of a species is the advent and establishment of another. Railroads, bringing about entirely new conditions, have offered favorable opportunities for the development and distribution of certain species, at the same time assisting in the immigration of others. It is realized that where the secondary influences act upon a country already modeled

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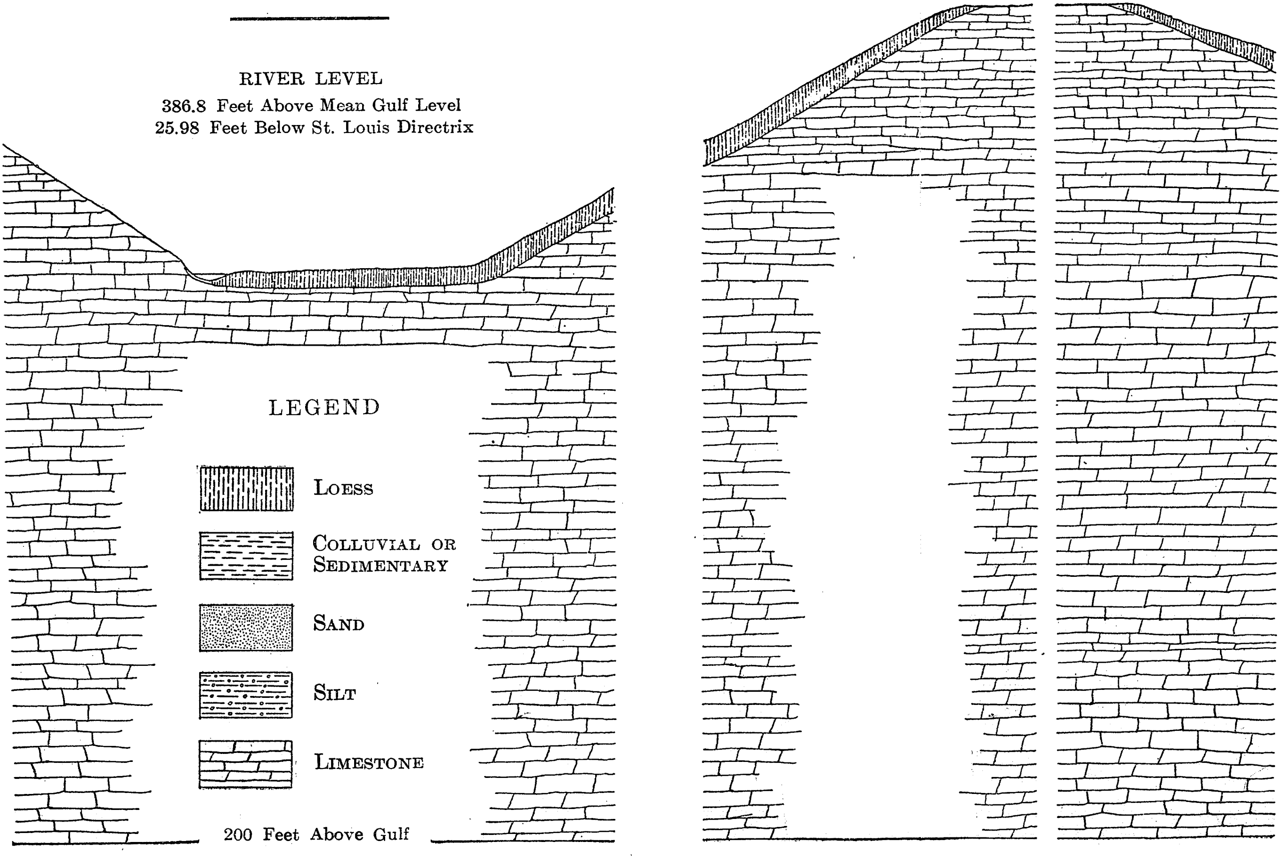
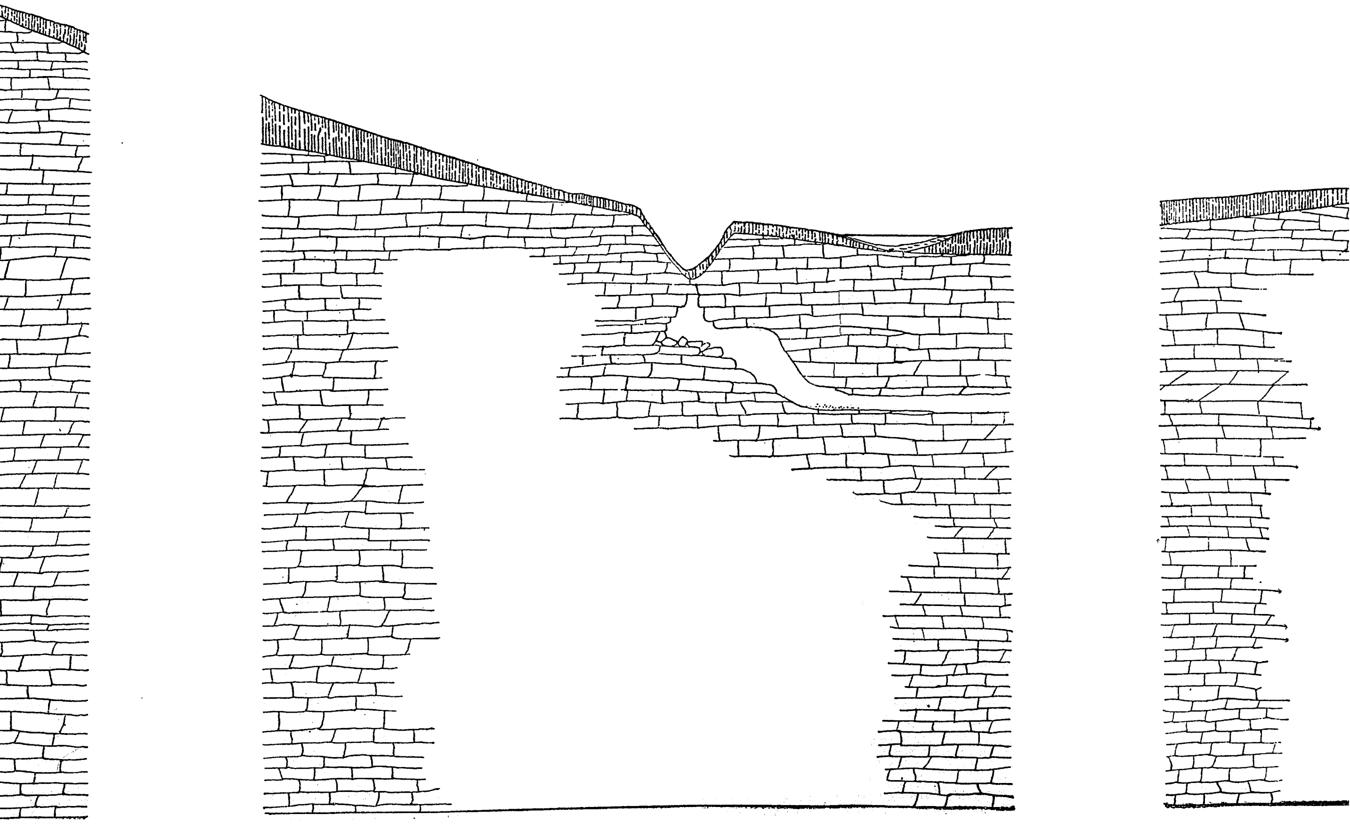
* A thesis presented to the Faculty of Washington University, in candidacy for the degree of Doctor of Philosophy, April. 1908.

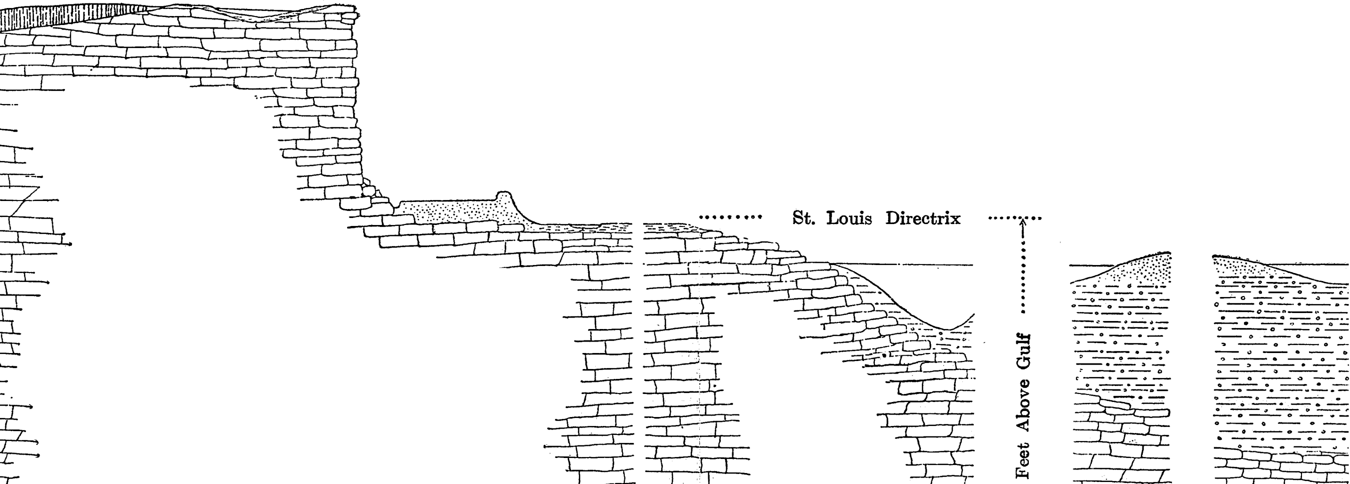
IDEAL CROSS SECTION
OF THE
MISSISSIPPI RIVER

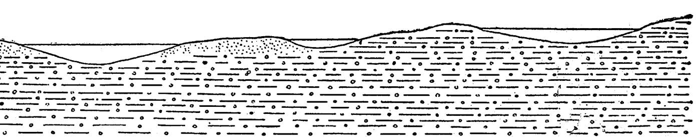
SCALE
1 Inch = 50 Feet
(In Breaks 1 Inch = 1 Mile

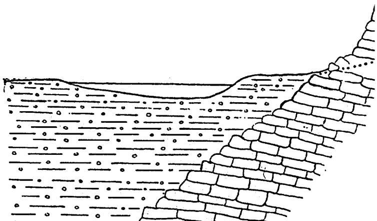
RIVER LEVEL
386.8 Feet Above Mean Gulf Level
25.98 Feet Below St. Louis Directrix

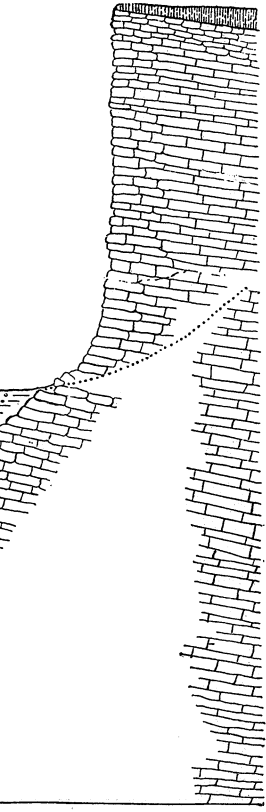





St. Louis Directrix
412.78 Feet Above Gulf







into distinct regions by primary physiographic forces, the effect upon the flora must be far reaching. In the following paper an attempt has been made to analyze the physiographic features of the river valley and to study the distribution of the local flora with reference to them.

Since a cross section of the Mississippi River, following a straight line laid down with mathematical precision, would not include the various features characteristic of the region described, the cross section made is an ideal one, exemplified in the accompanying diagram, embodying the principal physiographic features of the region studied. The section embraces, from east to west, the country lying between the rolling prairies of southwestern Illinois on the one hand and the Missouri plateau on the other, and includes portions of the two plateaus. On the Missouri side the area covered comprises the country between the mouth of the River des Pères and the mouth of the Meramec River. On the Illinois side the territory is bounded on the north by an east and west line drawn through a point approximately one mile north of Collinsville in Madison county and on the south by an east and west line drawn through a point about two miles south of Falling Spring, St. Clair county.

In the collection of data for and in the preparation of this paper the writer is indebted for valuable assistance to many friends, in the first place to Professor William Trelease, at whose suggestion the work was undertaken. To Professor Fenneman of the U. S. Geological Survey, to Messrs. Mitchell and Penneman of the Deep Water Way Commission, and to Mr. J. J. Lichter, thanks are due for information along geological lines, especially as far as borings in the American Bottoms are concerned, and to Mr. J. H. Kellogg of the Missouri Botanical Garden for numerous botanical data.

PHYSICAL FEATURES.

METEOROLOGY.

As pointed out by Clements,* unless meteorological readings are taken in each habitat, they are of no value to the ecologist except in giving a very general idea of the vegetation. Neither annual nor daily averages can be used to advantage. It is different where monthly or seasonal averages are concerned. The extremes also are of importance. For this reason certain of the data collected by others are given here.

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* Clements, F. E. Research Methods in Ecology. Lincoln. 1905.

TABLE A.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	An'l
1873				51	65	78	78	78	67	**52**	42	36	
1874	35	36	43	**47**	69	79	81	78	70	58	44	38	56
1875	23	26	40	51	64	72	78	**73**	67	54	41	44	**53**
1876	41	41	40	58	67	73	79	78	67	56	42	**25**	66
1877	31	42	39	55	64	74	78	76	70	61	43	48	57
1878	36	41	**54**	61	64	73	82	79	69	57	47	27	57
1879	28	34	48	55	69	74	81	76	66	64	48	35	56
1880	**47**	41	43	58	70	74	78	80	68	56	**33**	28	56
1881	**22**	31	40	52	72	76	82	**84**	**77**	62	44	42	57
1882	34	**45**	47	59	**60**	74	**75**	76	70	62	45	33	57
1883	24	31	40	57	63	73	78	75	68	57	50	41	55
1884	26	37	44	55	65	74	79	75	75	64	47	34	56
1885	26	27	41	57	65	75	82	76	69	57	48	39	55
1886	26	37	45	59	69	75	81	79	72	61	46	30	57
1887	31	41	46	61	71	77	84	79	70	54	45	32	**58**
1888	25	33	41	59	63	74	80	75	67	55	45	38	55
1889	35	31	47	58	64	71	78	75	67	55	41	**50**	56
1890	39	40	39	57	64	79	80	75	**65**	57	49	38	57
1891	37	36	39	59	64	76	**75**	75	74	58	41	43	56
1892	26	40	40	54	63	77	77	78	70	60	42	33	55
1893	25	31	44	57	64	75	80	76	73	59	44	36	55
1894	36	32	51	58	66	78	79	79	71	60	42	39	**58**
1895	26	25	44	60	67	77	76	78	74	54	43	37	55
1896	35	37	41	**65**	**73**	74	79	79	68	57	46	41	**58**
1897	31	37	47	56	64	75	81	77	**77**	**66**	46	33	57
1898	37	38	47	54	67	78	78	78	74	56	43	33	57
1899	33	24	40	58	69	77	79	81	70	64	52	33	57
1900	37	30	43	58	69	74	79	**84**	74	**66**	47	38	**58**
1901	37	31	45	54	66	**81**	**87**	80	72	62	44	30	57
1902	32	26	47	55	72	74	80	76	66	62	**53**	34	57
1903	34	34	49	57	69	**70**	81	77	70	59	42	30	56
1904	28	31	45	49	65	72	76	74	71	59	48	35	54
1905	24	**23**	50	56	67	76	75	78	71	56	47	35	55
1906	37	32	**34**	60	67	72	77	78	73	57	44	37	56
1907	36	34	53	**47**	59	71	79	77	69	56	44	38	55

MONTHLY AND ANNUAL MEAN TEMPERATURES.*

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* U. S. D. A. Weather Bureau. Annual Meteorological Summary, St. Louis, 1907.—In these tables, the Fahrenheit scale is used.—Highest and lowest temperatures in bold-face type.

TABLE B.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	An'l
1871	2.53	2.92	1.27	0.49	3.15	2.51	1.64	3.55	0.25	2.07	1.83	1.17	**23.38**
1872	0.64	1.15	2.43	2.77	6.04	4.28	4.59	0.93	3.38	0.55	2.01	1.70	30.47
1873	3.53	1.52	2.10	6.88	5.73	6.68	5.96	**0.07**	3.02	3.27	1.64	5.10	45.50
1874	3.14	3.66	4.36	3.44	3.70	2.00	5.71	4.70	2.30	1.09	2.32	1.46	37.38
1875	0.54	2.59	4.08	2.53	5.48	**10.84**	**9.50**	2.66	0.24	1.23	0.89	2.42	43.00
1876	4.75	2.86	6.90	2.35	3.13	6.43	5.90	5.03	7.63	1.66	1.74	**0.18**	48.46
1877	1.24	0.88	3.41	3.03	3.11	8.69	2.88	2.61	3.56	4.92	3.76	3.34	41.43
1878	2.36	1.69	2.79	6.74	4.63	2.40	3.92	4.75	3.42	3.27	1.38	3.48	40.83
1879	1.64	1.48	1.92	2.31	**0.95**	4.04	1.97	2.23	1.34	0.68	4.30	2.84	25.70
1880	3.83	2.65	2.51	3.31	3.44	2.56	5.17	1.53	3.10	2.09	2.67	1.80	34.66
1881	0.49	4.16	1.95	3.14	3.96	2.74	2.13	0.31	3.14	7.21	**6.74**	1.40	37.37
1882	2.80	**8.94**	3.49	3.58	4.55	4.53	3.84	2.20	1.73	2.44	3.24	1.81	43.15
1883	0.94	5.88	2.29	3.31	2.89	5.04	4.31	3.34	**0.01**	6.60	3.71	1.78	40.10
1884	0.79	4.43	3.00	4.15	2.68	4.52	2.86	1.21	6.04	2.48	2.30	**6.18**	40.64
1885	3.26	0.87	**0.40**	4.84	2.80	7.68	2.58	2.96	8.98	**7.51**	1.68	2.03	45.59
1886	3.11	1.71	3.04	2.10	7.84	7.09	0.55	2.44	**9.60**	0.85	3.36	2.65	44.34
1887	0.65	3.68	3.54	4.36	5.27	2.54	2.74	1.14	2.47	0.76	4.61	3.54	35.30
1888	2.15	2.39	3.79	1.88	3.81	8.09	2.09	**6.66**	1.31	2.59	4.40	2.01	41.17
1889	3.04	4.78	1.62	1.68	3.80	4.72	2.02	0.85	3.54	1.65	4.43	1.03	33.16
1890	**7.47**	2.86	5.99	4.05	5.81	3.18	**0.37**	2.43	1.80	0.86	1.55	1.32	37.69
1891	1.35	2.95	22.9	2.29	2.73	5.97	1.50	2.75	1.43	0.65	5.30	1.32	30.53
1892	1.52	4.89	1.92	7.60	7.87	2.73	4.64	1.75	1.59	1.66	3.46	1.99	41.62
1893	**0.33**	2.98	5.10	**10.84**	5.42	3.49	2.49	0.65	3.69	1.66	1.36	1.32	39.33
1894	2.56	2.88	2.69	2.68	3.61	**1.12**	1.35	1.66	3.11	1.56	1.49	2.73	27.44
1895	1.65	**0.43**	2.82	**0.46**	3.16	2.46	7.26	2.08	2.01	**0.23**	3.98	4.66	31.20
1896	1.43	2.81	2.03	2.43	**9.12**	4.57	4.67	2.12	2.42	1.20	3.70	1.05	37.55
1897	3.75	2.67	**8.25**	4.66	1.59	5.32	3.23	0.66	0.09	0.31	6.21	3.43	40.17
1898	4.53	1.71	7.73	3.85	8.55	3.85	7.44	0.87	3.23	4.34	2.07	1.03	**49.20**
1899	1.66	3.40	3.96	1.98	6.32	2.32	4.54	2.77	1.27	2.89	1.95	1.55	34.61
1900	0.65	5.09	1.45	1.83	4.47	2.62	3.85	1.30	2.68	2.07	3.10	0.40	29.51
1901	1.12	1.86	2,94	2.35	2.69	3.92	1.47	0.76	0.64	2.12	1.21	3.72	24.80
1902	1.18	0.83	4.50	2.49	3.04	7.86	2.34	5.20	1.98	2.00	3.20	3.81	38.43
1903	1.76	3.14	3.20	2.79	2.08	5.71	2.68	6.16	3.06	1.37	0.61	1.25	33.81
1904	3.15	0.84	7.87	3.25	2.88	4.64	3.09	2.62	2.97	0.50	**0.54**	1.36	33.71
1905	2.47	1.12	2.35	2.32	4.67	2.72	4.42	2.58	5.56	6.64	1.63	2.06	38.54
1906	3.57	2.92	4.53	1.98	2.61	2.80	0.98	3.72	4.40	1.25	4.67	2.09	35.52
1907	7.35	1.12	2.39	3.65	5.57	4.96	3.32	4.36	1.57	3.15	1.89	2.06	41.39

MONTHLY AND ANNUAL PRECIPITATION.*

TABLE C.

Month	Temperature						Precipitation			Wind			
	Max.	Year	Day	Min.	Year	Day	24hr. Max.	Year	Day	Max. Vel.	Dir.	Year	Day
January....	74	1890	11	—22	1884	5	3.57	1890	1	66	SW	1898	25
February...	78	1890	4	—18	1905	13	4.44	1882	19–20	62	SW	1904	7
March......	90	1907	21	3	1899	7	3.58	1904	24–25	60	W	‡1880	21
April.......	91	1899	29	22	1875	17	3.97	1878	22–23	60	SW	1904	8
May	94	1875	31	32	1872	2	3.39	1886	14–15	80	NW	1896	27
June.......	102	1901	29	44	1894	6	4.80	1902	28	61	W	1882	17
July	107	1901	24	55	1891	9	5.08	1898	7–8	58	W	1900	24
August	106	1881	12	52	1887	24	3.04	1878	9–10	72	NW	1878	4
September ..	102	†1881	5	37	1899	30	3.47	1885	3–4	48	SW	‡1890	11
October	91	1897	5	24	1887	25	3.26	1905	17–18	54	S	1887	23
November..	82	1879	13	5	1872	29	2.99	1881	17–18	58	SW	1898	21
December...	74	1875	31	—14	1872	24	2.61	1873	2–3	60	NW	1885	4

EXTREMES.*

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* U. S. D. A. Weather Bureau. Annual Meteorological Summary, St. Louis, 1907.—Precipitation is recorded in inches.—Greatest and least precipitation in bold-face type.—Wind-velocity in miles per hour.—† Also 1899 on the 5th. ‡ And other dates.

From the temperature table given (A) the following data have been calculated. The mean covers the period from 1874 to 1907. The seasonal division here made is: spring, March, April, May; summer, June, July, August; autumn, September, October, November; winter, December, January, February.

TABLE D.

Seasonal Mean				Annual Mean	Extremes	
Winter	Spring	Summer	Autumn		Maximum	Minimum
33.94	55.55	77.18	52.67	56.47	107	-22

AVERAGE AND EXTREME TEMPERATURE.

A comparison of normal temperature and precipitation for St. Louis, given by Fippin and Drake,* is reproduced as Table E.

TABLE E.

Month	Temperature	Precipitation	Month	Temperature	Precipitation
January	30.5	2.18	July	78.8	3.76
February	35.1	2.78	August	76.8	3.50
March	43.1	3.49	September	69.4	3.12
April	56.2	3.79	October	57.5	2.89
May	65.8	4.58	November	43.6	3.10
June	75.2	5.08	December	35.6	2.81

NORMAL TEMPERATURE AND PRECIPITATION.

It is almost unnecessary to state that figures obtained for various stations in our section show marked differences. Even where conditions are fairly uniform the differences are striking. This is well illustrated by Table F, containing figures taken from a paper by Nipher.†

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* Fippin, E. O. and J. A. Drake. Soil Survey of the O'Fallon Area, Missouri-Illinois. Rept. U. S. D. A. Bureau of Soils. **6** : 817. 1904.

† Nipher, F. E. Report on Missouri Rainfall, with Averages for ten Years ending December, 1887. Trans. Acad. Sci. St. Louis. **5:** 383. 1889.

TABLE F.

Locality*	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Station 1...	2.80	8.94	3.49	3.58	4.55	4.53	3.84	2.20	1.73	2.44	3.24	1.81	43.15
Station 2...	3.68	7.21	3.39	4.30	4.36	4.78	3.56	2.53	1.46	2.33	3.16	1.75	42.51
Station 3...	2.34	6.99	3.57	3.47	4.22	4.57	1.10	2.07	1.38	3.21	2.77	1.49	37.18
Station 4...	2.80	6.96	2.14	3.17	4.89	3.80	4.30	3.52	1.71	2.42	4.00	1.16	40.87
Station 5...	2.87	6.54	3.29	2.16	4.29	4.94	4.84	2.67	2.73	3.55	3.04	1.84	42.76

RAINFALL IN OR NEAR ST. LOUIS, 1882.

An excellent exposition of the relations existing between soils and plant growth on the one hand and temperature on the other, as well as of the influence of precipitation, is given by Hilgard.† Unfortunately there are no records available for our different habitats. Yet data obtained from two points, the one to the northwest, the other to the southeast of our territory, do not show a very great difference, as is exemplified by Table G.

TABLE G.

Month	Temperature			Rainfall		
	St. Louis	Mascoutah	Diff.	St. Louis	Mascoutah	Diff.
April	56.1	53.6	+2.5	3.52	3.94	—.42
May	66.5	64.0	+2.5	4.24	4.67	—.43
June	75.1	74.0	+1.1	4.47	4.22	+.25
July	78.7	77.9	+ .8	3.21	3.09	+.12
Aug.	77.2	75.7	+1.5	2.66	2.78	—.12
Sept.	70.0	69.4	+ .6	2.91	3.44	—.53
Oct.	58.4	56.6	+1.8	2.41	2.21	+.20
Nov.	43.4	42.9	+ .5	2.88	3.26	—.38
Dec.	35.5	34.5	+1.0	2.23	2.38	—.15

ST. LOUIS, MO., AND MASCOUTAH, ILL., 1907.‡

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* Station 1, St. Louis Signal Service. Gauge on the roof of the St. Louis Life Insurance Building, 6th and Locust Sts.—Station 2, Washington University. Gauge 6 feet above the ground in the rear yard of a dwelling on the S. E. cor., 18th St. and Washington Ave.—Station 3, St. Louis Waterworks. Top of gauge 16 inches above the ground with no tree or building within 75 yards.—Station 4, Jefferson Barracks, St. Louis Co., Mo.—Station 5, Mascoutah, St. Clair Co., Ill. Gauge 3 feet above ground.

† Hilgard, E. Soils. 289, 305, 310. New York. 1908.

‡ Compiled at the St. Louis Weather Bureau from data in U. S. D. A. Weather Bureau. Climatological Report, Illinois Section. **12**^{13}. 1907.

The main point to be remembered in judging temperature conditions in the field from data obtained in the city is that true extremes are seldom obtained in the latter location on account of the lesser radiation of brick structures. Both in winter and summer, during the day as well as at night, the extremes of temperature are less in the cities than in the field. This is largely due to the lack of protection from wind of stations in the field.

If the differences to be observed in the temperature of various stations in the territory having similar aspect are so slight as to be negligible, this is not so where the formations are of a different nature. Measurements at various stations have shown a variation of from 2 to 10° C. at approximately the same hour and on the same date. In summer the temperature of the oak woods is at least 4° C. lower than that of the field, while at night it is as much higher. This figure is based on a limited number of observations made near Jefferson Barracks during 1907. The need of automatic instruments for the registration of temperatures, etc., is, however, indicated. This, in the vicinity of a large city, appears to be hopeless, even the most simple and seemingly well-hidden instruments being subject to vandalism.

In a former paper* attention was called to the protective action of forests, preventing extremes of temperature and moisture, as shown by Ebermayer.† Comparative observations made in Europe, in a beech forest situated at an altitude of 400 m., gave the following results:

TABLE H.

Temperature	In the wood		In the open	
	Max.	Min.	Max.	Min.
At surface......................	21.5	....	28.6	....
One half foot below surface......	18.4	—2.5	24.5	—4.6

SOIL TEMPERATURES.

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* The Germination of *Hydrastis canadensis.* Rept. Mo. Bot. Gard. **18**:85. 1907.

† Ebermayer, E. Die physikalischen Einwirkungen des Waldes auf Luft und Boden, etc. **1.** Aschaffenburg. 1873.—Temperatures in degrees of the Centigrade scale.

From this it will be seen that at the surface the highest temperature was 7.1° C. higher in the open than in the wood, while half a foot below the surface a difference of 6.1° C. was found. It will also be noted that in winter the temperature of the soil half a foot below the surface was considerably higher in the wood than in the open.

Not only are plants growing in woods protected from extreme temperatures, but they also enjoy a fairly uniform degree of humidity of the soil. Another factor which frequently plays a great part in the presence of plants in certain localities is the air current. This is true especially where occur ravines such as we find at Cliff Cave. Just how these air currents affect plant growth will be shown later.

Another important factor, not to be lost sight of because of its intimate relation to plant distribution, is the ratio existing between evaporation and rainfall, as shown by Schimper.* In the section studied, the rainfall is between 60 and 80% of the evaporation.† Naturally the nature of the plant growth, etc., modifies this ratio to a great extent, as shown experimentally by Livingston,‡ by means of his simple and ingenious atmometer.

A seeming gradual decrease of rainfall in this section,§ may have exerted a great and lasting influence upon the local flora, though records by means of which such changes could be followed are unfortunately not available.

Important climatological influences upon the flora are exerted by the daily extremes of temperature, especially those occurring during the earlier part of the year, which act not only upon the plants themselves but also upon the limestone rock. Alternate periods of freezing and thawing can be supported by the winter-rosettes of the hardiest plants only. Differences of 30° F. are not infrequent, and since the minimum is ordinarily several degrees below the freezing point, these factors likewise assist to some extent in the disintegration of the rock surface, especially since the limestone is porous and absorbs a considerable amount of water. However, the St. Louis limestone appears to be able to withstand climatic influences so well that locally it is largely used as a building-stone. While there is a considerable variation in its composition, on the whole it may be said that laboratory tests have shown that the crushing strength of samples subjected to freezing was not seriously diminished.* Hence changes in temperature probably do not greatly affect the rock surface. On the other hand, they serve to pry apart, at the fissure joints, those blocks of limestone which are situated near the surface.

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* Schimper, A. F. W. Pflanzengeographie. 174. Jena. 1898.

† Transeau, E. N. Forest Centers of Eastern America. Am. Nat. **39**: 875. 1905.

‡ Livingston, B. E. Evaporation and Plant Development. The Plant World. **10**: 269. Dec. 1907.—Evaporation and Plant Habitats. The Plant World. **11**: 1. Jan. 1908.

§ Trelease, W. Thirteenth Annual Report of the Director. Rept. Mo. Bot. Gard. **13**: 16. 1902.

GEOLOGY.

But few geological or paleontological papers deal exclusively with the region or part of the region under discussion and the various publications treating of those parts of Illinois and Missouri, situated along the banks of the Mississippi in the vicinity of St. Louis, must be taken into consideration.

As far as Missouri is concerned, previous to the first State Geological Survey, none but the most general features had been recognized, the main interest being centered on the metal, ore and coal producing regions. A summary of such geological work as had been done, is given by Swallow,† with whose appointment as State Geologist was inaugurated a new era, during which were studied not only the different geological formations, but also the fossils which they contained, something which up to that time had been practically neglected.

As far as the vicinity of St. Louis is concerned, it was especially the work of Dr. B. F. Shumard which contributed largely to a detailed and accurate knowledge of its geology and paleontology. Especially from the standpoint of the latter science the field is exceedingly rich and attractive, so that at the present time its contents are well studied. Among the 800 or more publications mentioned, in 1890, by Sampson * as dealing with the geological problems of Missouri, a large percentage treat of paleontology only. A bibliography, more ample and arranged according to a different system, is given by Keyes,† since the publication of which a number of others, dealing with St. Louis county, have appeared. They are to be found chiefly among the publications of the U. S. Geological Survey and in the Proceedings of the Academy of Science of St. Louis.

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* Buckley, E. R., and H. A. Buehler. The Quarrying Industries of Missouri. Mo. Bureau Geol. and Mines. 2 ser. **2.** 1904.

† Swallow, C. G. First and Second Annual Report of the Geological Survey of Missouri. Appendix A. 1855.

For the geology of that part of Illinois considered in the present paper, the publications of the Geological Survey of Illinois and those of the U. S. Geological Survey have been drawn upon for information. Further bibliographic references are given by Weeks.‡

THE MISSOURI SECTION.

In this portion of our territory the Pleistocene, the Carboniferous and the Silurian periods are represented, though not all of them are exposed. Neocene, Eocene, Cretaceous and Jura-Trias are entirely lacking here and in the adjacent territories, both in Missouri and Illinois. The coal measures are found in the Illinois portion of our territory as well as immediately north of the Missouri section, above the mouth of the River des Pères. The latter are a portion of the Illinois coal field.§

An excellent idea of the formations, as occurring in St. Louis county, may be obtained from a general section pub-

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* Sampson, F. A. A Bibliography of the Geology of Missouri. Geological Survey of Missouri. Arthur Winslow, State Geologist. Bulletin **2** : 5. 1890.

† Keyes, C. R. Bibliography of Missouri Geology. Missouri Geological Survey. Charles Keyes, State Geologist. **10** : 219. 1896.

‡ Weeks, F. B. Bibliography of North American Geology, Paleontology, Petrology and Mineralogy for 1892–1900 inclusive. Bull. U. S. Geol. Survey. 188. 1902.—Index to North American Geology, Paleontology, Petrology and Mineralogy for 1892–1900, inclusive. Bull. U. S. Geol. Survey. 189. 1902.

§ Gallaher, Jno. A. Preliminary Report on the structural and economic Geology of Missouri. Missouri Geological Survey. **13** : 167. 1900.

lished by Ladd.* It is understood that as a result of recent investigations by members of the U. S. Geological Survey, this column should be modified to some extent. As it stands at present it is a compilation of the work accomplished in this section along geological lines since its inception by Shumard in 1854 and up to 1890. It was especially the boring of a well at the Insane Asylum at St. Louis, sunk to a depth of nearly 4,000 feet, which threw light upon the rocks which in no place in this vicinity reach the surface.†

Quaternary Deposits.

The most detailed description of the quaternary formation of the Missouri portion of our section is that by Todd.‡

1. Recent Alluvium.—The alluvium deposited by the Mississippi is in part derived from the Missouri River which enters the former about ten miles north of St. Louis. It is mainly composed of sand, with coarser material towards the bottom. On top of the sand we find clay or mixtures of sand and clay. These deposits, which are numerous but variable, both in size and locality, are also the first stages of the sandbar formations. On the west bank of the Mississippi occur wider or narrower bottoms, overflowed at times of flood only. Their subsoil, to a depth of several feet, is a heavy loam laid down by the river. Owing to the growth of tall annuals which during the summer and autumn cover these banks, the loam is soon covered by a thick mat of decaying vegetation forming a rich, black soil. As a result of the nature of the shore south of St. Louis, terrace formations are absent.

2. Loess.—This name is applied to the loamy clay which in layers of varying thickness, sometimes as much as 50 feet, overlies the St. Louis limestone, owing its name to its resemblance to certain sedimentary deposits, thus designated,

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* Ladd, G. E. The Clay, Stone, Lime and Sand Industries of St. Louis City and County. Geological Survey of Missouri. Bull. 3. 1890.

† Broadhead, G. C. On the Well at the Insane Asylum, St. Louis County. Trans. Acad. Sci. St. Louis. **3**: 216. 1878.

‡ Todd, J. E. Formation of the Quaternary Deposits. Missouri Geological Survey. Charles R. Keyes, State Geologist. **10**: 111. 1896.

in the valley of the Rhine. Todd * describes it as follows: "Loess . . . is composed mainly of fine grains of silica some of which attain the size of .2 mm., though the majority are less than .01 mm. These particles are coated, more or less, with oxide of iron and calcic carbonate. The amount of the former gives it the color which in the typical form is usually a light buff. With it is mixed many small grains of clay. The finer ingredients appear to constitute a cement which holds it firmly together so that it usually stands firm like indurated rock, unless softened by moisture." An increase in the amount of oxide of iron increases the intensity of the color of the loess. Its absence is indicated by a gray or even whitish color.

3. Bouldery drift.—This underlies the loess, and covers the surface along the western bank of the Mississippi below St. Louis as far as the mouth of the Meramec, occupying a strip two to five miles wide.† Interesting in this connection is Wheeler's paper, bearing on the occurrence of blue glacial clay or "till" at St. Louis.‡ From this it appears that there exists some doubt as to the glacial origin of the drift above referred to. However, more recent work, as yet unpublished, seems to eliminate such a doubt.

Subcarboniferous System.

The ferruginous sandstone of the Chester group which in other portions of St. Louis county underlies the coal measures and in places attains a thickness of 250 feet, is, in our territory, represented by a thin layer of sandy shale, never more than a few feet in thickness. It directly overlies the St. Louis limestone. The latter is a very hard, fine-grained rock, varying in color from light yellow to light-gray and blue-gray. It is evenly bedded, the strata varying in thickness so as to yield both dimension stone and flagstone. It is interstratified with layers of argillaceous shale. Some of the lime-

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* *loc. cit.*

† Wright, G. F. U. S. Geol. Surv. Bull. **58** : 72-73. 1890.

‡ Wheeler, H. A. Note on the Glacial Drift in St. Louis. Trans. Acad. Sci. St. Louis. **7** : 121. 1895.

stone strata are a nearly pure carbonate of lime, in other strata the limestone is mixed with sand. The beds are nearly horizontal, having a slight inclination to the northeast. The first detailed description accessible is that of Engelmann.* It reaches its greatest development on the western shore of the Mississippi between the mouth of the River des Pères and the mouth of the Meramec. It contains many characteristic fossils. The total thickness of the St. Louis limestone is estimated at 250 feet, of which, along the bluff, from 40 to 120 feet are exposed. The entire section is as follows:

Lower Carboniferous	St. Louis	250 ft.
	Keokuk	225 ft.
	Burlington	200 ft.
	Chouteau	65 ft.
Lower Silurian		800 ft.

THE MISSISSIPPI RIVER.

The Mississippi River, which in our section closely follows the bluffs on the western side, is of varying depth. Its channel, which for the greater part is situated on the Missouri side, varies in depth from 10 to 58 feet,† and is cut in the alluvial deposit.

The depth of the alluvial deposit is not known with exactitude. Todd says: "At St. Louis there are varying depths from low water to bedrock: at the east end of the Eads bridge it is 95 feet, at the east pier of Merchants' bridge it is 45 feet, in a well at the Tudor Iron Works 79 feet." The bedrock is the St. Louis limestone.

THE ILLINOIS SECTION.

In the Illinois section, the Quaternary, Carboniferous and Silurian systems are recognized.‡ The Quaternary system, quantitatively, in depth as well as in area, is better represented than in the Missouri section.

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* Engelmann, G. Remarks on the St. Louis Limestone. Amer. Journ. Sci. and Arts. 2 ser. **3** : 119. 1847.

† Survey of the Mississippi River, made under the Direction of the Mississippi River Commission. Chart 114.

‡ Worthen, A. H. Geological Survey of Illinois. **1** : 21. 1866.

Quaternary Deposits.

In their deposition and arrangement the Mississippi, which, unlike most rivers in southern Illinois, follows the pre-glacial drainage lines,* played an important part.

1. Recent alluvium.—This is of the same nature as that in St. Louis county, however, it overlies a bed of sediment consisting chiefly of an upper sandy portion and a lower part composed of gravel and pebbles. This is well shown by the boring made during the summer of 1905 in the vicinity of Monk's Mound, Ill., just north of the line dividing St. Clair and Madison counties. Records of the borings, of which samples were placed in the museum of the Academy of Science of St. Louis through the agency of Mr. J. J. Lichter, were published by Bowman† and are here reproduced as Table I. In this table, which was verified by a comparison with the samples just mentioned, certain of the borings which appeared to be identical, have been added together for the purpose of condensing the table.

It is doubtful whether the deposits above referred to are of glacial origin. Bowman,‡ while granting that the ice may have brought down and filled in a portion of the material, believes it more rational to suppose "that the river and tributaries brought in the material from the thick glacial deposits which cross the river higher up and from the bluffs nearby." How rapidly the river is building out the flood plain may be judged by the fact that Cahokia, one mile east of the river, in 1850 was situated on the bank of the river. The tributary streams too carry large burdens, as evidenced by the deposits near French Village, or the instance quoted by Bowman who mentions the fact that the southern outlet to Pittsburg Lake has been largely closed up by bluff sediments of Druit Creek.

2. Loess.—This covers the hills to a greater or less depth, and often reaches a thickness of 60 feet, as at the quarry near

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* Leverett, F. The Water Resources of Illinois. U. S. Geol. Surv. Ann. Rep. **17**^{2} **:** 706. 1895–1896.

† Bowman, I. Water Resources of the East St. Louis District. Ill. State Geol. Surv. Bull. **5 :** 106–107. 1907.

‡ *loc. cit.*

TABLE I.

SECTION.	Feet.	
	Thickness.	Depth.
Dirt	40	40
Gray sand	20	60
Very coarse sand, grains of various rock as if glacial material	10	70
Coarse sand and gravel pebbles of brown and yellow quartzite, greenstone, etc., shells, fragments	80	150
Black clay, almost non-calcareous	55	205
Limestone fragments, may be mixed shale and clay	5	210
Gray, non-calcareous shale	5	215
Light black, clay or shale, non-calcareous	5	220
Same laminated, gray and white	5	225
Gray limestone churned to a very fine sand	5	230
Gray, very siliceous limestone, possibly chert, but looks like sand grains; comes in large fragments	5	235
Very fine white to gray sandstone, almost non-calcareous	65	300
Light colored limestone, churned to very fine sand	5	305
Light sandstone, very fine	10	315
Dense white limestone	45	360
Darker limestone	20	380
Light limestone, dense	30	410
Very ferruginous limestone	10	420
Very ferruginous limestone, cherty	20	440
Dense gray limestone	50	490
Lighter limestone	15	505
Gray limestone	10	515
Darker limestone	10	525
Limestone and chert, very ferruginous	10	535
Limestone less ferruginous	45	580
Limestone less ferruginous, finely powdered	10	590
Limestone less ferruginous, some chert	35	625
Limestone, largely chert, crinoid stems	25	650
Dark gray limestone	20	670
Mostly white chert	10	680
Light colored limestone, often stuck together with light colored clay which may have been largely washed out	38	718
Blue calcareous clay	62	780
Gray cherty limestone	10	790
Nearly all white chert, finely powdered but angular	10	800
Limestone and white chert	10	810
Largely white chert, finely powdered but angular	30	840
Largely white chert, finely powdered but angular	10	850
Largely white chert, as fine as glass sand	20	870
Limestone and white chert	10	880
Largely white chert fragments	15	895
White limestone and white chert	55	950
Largely white chert fragments	15	965
Greenish gray limestone	30	995
Greenish gray limestone, much chert of similar color	20	1,015
Pink calcareous clay	30	1,045

BORINGS NEAR MONK'S MOUND.

TABLE I.—*Continued.*

SECTION.	FEET.	
	Thickness.	Depth.
Limestone white to green and red, crinoid stems	5	1,050
Light green calcareous plastic clay	2	1,052
Light colored dense limestone	18	1,070
Light colored dense limestone, finely churned	5	1,075
Mainly limestone but has Fern Glen fragments, grains.	3	1,078
Finely powdered pink limestone like Fern Glen, large silica grains, round	3	1,081
Finely powdered but more gray limestone fragments	14	1,095
Dark blue clay, slightly calcareous	10	1,105
Blue shale fragments, calcareous	20	1,125
Blue shale fragments, more gritty, non-calcareous	10	1,135
Gray limestone chips	35	1,170
Gray to brownish pink gritty limestone, fragments are almost all pink	25	1,195
Greenish gray limestone fragments	10	1,205
Gray and pink gritty	5	1,210
Gray and pink gritty	3	1,213
Gray and pink gritty, but churned to very fine sand	12	1,225
Gray limestone chips	5	1,230
Gray limestone chips, pink fragments still intermixed	20	1,250
Gray limestone chips, mostly pinkish	5	1,255
Light gray limestone, in sharp chips	5	1,260
Light gray limestone	5	1,265
Light gray limestone, finer sand more rounded	5	1,270
Light gray limestone	5	1,275
Light gray limestone, pyrite noted	5	1,280
Light gray limestone, except pyrite	5	1,285
White limestone ground to coarse sand	10	1,295
White limestone ground to coarse sand	5	1,300
White limestone fragments	15	1,315
White limestone in rounded grains, some gray and appear very siliceous	10	1,325
White limestone, but none of the gray siliceous grains.	10	1,335
Greenish gray shale, almost non-calcareous	45	1,380
Dark gray or greenish gray limestone, soft enough to be a calcareous shale	110	1,490
Pinkish white, probably siliceous limestone	20	1,510
Probably siliceous limestone, milk-white	70	1,580
Siliceous chips, large admixture of dark gray slaty grains, non-calcareous	20	1,600
Siliceous chips, large admixture of dark gray slaty grains, non-calcareous	50	1,650
Siliceous chips, the gray disappearing	30	1,680
Gray limestone	20	1,700
Lighter, yellow limestone	30	1,730
Lighter, yellow limestone	25	1,755
Lighter, yellow limestone	20	1,775
Brown gray limestone, churned to fine sand	200	1,975
Siliceous sand, round grains, plainly St. Peters	100	2,075
Siliceous sand, round grains, plainly St. Peters	25	2,100

BORINGS NEAR MONK'S MOUND.

Stolle, but thins out towards the east. Worthen * deems it probable "that it was accumulated when the present valley of the river was occupied by a chain of lakes, the waters of which filled it nearly to the height of the adjacent highlands, and that it was originally spread over the whole surface of the valley. A considerable portion of it was no doubt removed during the drainage of the valley by the gradual elevation of the surface and other portions have been subsequently removed by the action of river currents." Interesting in this connection is the opinion expressed by Hershey.†

3. Bouldery Drift.—The drift originally covered the highlands to a depth of 10 to 50 feet and was accumulated while the whole surface was under water. It consists mainly of yellow and brown clays intermingled with gravel, with here and there an occasional boulder. Till, a blue, plastic clay, ordinarily underlies the deposit, and between the blue and the yellow clays there is sometimes a stratum of sandy material, a few feet in thickness.

While ordinarily the loess is bedded on the drift and the latter overlies the stratified rock, it sometimes occurs that the drift apparently has been removed by currents previous to the deposition of the loess, in which case the latter lies immediately upon the rock.

Carboniferous System.

This, both in Madison and St. Clair counties, comprises the lower portion of the coal measures and the sub-carboniferous limestones. There is here a dip of the limestone which, disappearing just below Alton, reappears about Pittsburg, Ill. These coal measures have a thickness of 300 feet or more. They underlie nearly all the upland in St. Clair and Madison counties, but are greatest in the eastern portion, thinning out towards the river bluffs. They are composed of shales, either sandy, calcareous or bituminous, and a few comparatively thin strata of fireclay, limestone and coal. The coal seams vary from 6 inches to 4 feet in thickness. Here

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* *loc. cit.* 298.

† Hershey, O. H. The Loess Formation of the Mississippi Valley. Science N. S. **5** : 768. 1897.

and there the first workable coal is found comparatively near the surface, as at Edwardsville, where the arrangement is as follows:

Loess and drift clay, about	60 ft
Broken shale	2 ft.
Limestone	5 ft.
Coal	2 ft.
Hard, blue, argillaceous limestone alternating with bands of calcareous shale	16 ft.
Coal (Belleville No. 1 c)	6 ft.

In other places the coal lies 250 feet deep. Worthen,* describing the coal measures, says in substance:

The coal measures in St. Clair county comprise a thickness of about 300 feet of the lower part of the coal series, embracing the horizon of five coal seams only two of which appear to be of economic value at the present time. . . The western boundary of the coal measures intersects the river bluffs about two miles below Centerville station . . . and from that south to a point two miles south of the town of Centerville and then with a south easterly trend it crosses the Okaw near Tamaroa. Northward from the point where the boundary line intersects the bluffs, it follows the course of the bluffs in a northeasterly direction to the south line of Madison county, just north of Caseyville. Dip is moderate and in an easterly direction. . . . These beds form a continuous outcrop from their first appearance in the river bluffs about 1½ mile below Centerville station to the north line of the county, about 1½ mile north of Caseyville. . . . Belleville coal seam No. 1 C is the principal one worked. Above this coal there is sometimes a foot or more of bituminous shale but more frequently the coal is directly overlaid by the limestone and also underlaid by limestone. Above the limestone which forms the roof of the Belleville coal we usually find bands of calcareous and sandy shales, varying in thickness from 10 to 20 feet and on the small creek just north of Belleville these shales terminate upward in a bed of light gray clay shale, resembling a fire clay. This clay shale contains fossils . . . and is overlaid by another limestone 10 to 12 feet thick . . . quarried for building stone. In the river bluffs at the old Pittsburg mines it is only about 4 feet thick.

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* Worthen, *loc. cit.*

Referring to the western boundary of the coal measures, mentioned in the passage just quoted, Bowman* points out that "at Granite City the river sediments rest on the massive bed of the Mississippian limestone, while at Monk's Mound and near Peters they rest respectively on a shale and a sandstone which are undoubtedly coal measures strata." He expresses the opinion that the line of contact between the Mississippian and Pennsylvanian formations in the American Bottoms, while not known with exactitude, is probably somewhere between the eastern edge of East St. Louis and Monk's Mound. As has been pointed out previously, it is probable that the Pennsylvanian formation extended across the flood plain of the Mississippi, since "coal measures rocks are found not only in the bluffs from Centerville around to North Alton and in sections of deep wells near Monk's Mound and Peters, but beyond the Mississippi in the City of St. Louis and districts to the west and northwest. This was probably the condition in preglacial times, since geologists are agreed that the river trimmed the present bluff line previous to the glacial epoch."

The subcarboniferous limestone, which in the southern portion of the adjoining county of Randolph is at least 600 feet thick, has thinned out, before reaching the southern part of St. Clair county, to an aggregate of less than 100 feet, and includes only the lower sandstone and a thin bed of limestone. These beds outcrop around the southwest borders of the coal field in St. Clair county, commencing in the river bluffs, about 2 miles below Centerville station. Worthen describes it in substance as follows:

The limestone is a coarse-grained, thin-bedded gray or brown limestone, with partings of argillaceous material and contains numerous characteristic fossils. The entire thickness may be 20 to 30 feet. It is overlaid by the shales and argillaceous limestones of the Coal Measures, inclosing a

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* *loc. cit.*

thin coal seam. There is an outlier of this limestone on the south side of the anticlinal axis that intersects the river bluffs just above the Monroe county line. North of this axis we did not find this limestone exposed anywhere in the river bluffs in this county. The lower sandstone of the Chester group underlies the limestone just described and its outcrop is consequently over a belt of country to the south and west of that occupied by the limestone. The St. Louis limestone makes its first appearance in the river bluffs about 3 miles below Centerville station, where it comes up from beneath the sandstones just described, and it forms the main portion of the bluff from this point to the Monroe county line. At the old lime-kilns, 4 miles below Centerville station, it forms a mural cliff from 60 to 70 feet high and continues gradually increasing in elevation to Falling Spring where it measures 115 feet in thickness above the level of the Mississippi Bottoms. It presents here its usual characters of a regularly bedded fine-grained limestone, of a light gray color and compact structure. The beds vary in thickness from 3 inches to 2 feet or more. The upper portion of the mass is a very pure carbonate of lime and appears to be as well adapted to the manufacture of quicklime here as it is at St. Louis and Alton. As we approach the Monroe county line the beds continue to rise and the brown magnesian and semi-oölitic limestones that constitute the lower division of this group are elevated above the surface and compose the main portion of the bluff at the anticlinal axis, about 1 mile above the southern line of the county. Immediately below the axis the upper beds of the group again form the entire bluff, and with a reversed dip, at an angle of about 30 degrees, they plunge below the level of the Mississippi Bottom. The uppermost beds of this group are well exposed in the vicinity of Lark's quarries, about 4 miles from the Centerville station. At this locality the upper layers of the limestone are quite massive and afford solid blocks of limestone from two and one-half to three feet thick. . . . .
At the old lime-kilns, above Falling Spring, we obtained some characteristic fossils. . . . This limestone outcrops only over a very limited area in the southwest corner

of the county, probably not more than one-half of a single township. It is probable that the upper beds of the Keokuk group are elevated above the surface at the axis above referred to but we met with no exposure of them.

SOIL.

The first report on the soils of Missouri was that of Swallow* in which those of St. Louis county received but brief mention. The statement is made that a part of St. Louis county possesses a very superior soil and from what follows is gathered that reference is made to "the valley west of the city and in the Florissant." The soil of the bluffs appears to be inferior to this.

The upland portion of that part of our territory situated in Missouri may be classed under two heads, the more elevated portion where the soil directly overlies the limestone, and the less elevated portion, where the soil is formed on and by the upper portion of the loess which covers the limestone to a considerable depth.

As far as the latter portion is concerned, the soil here is a typical loess soil which in its upper layers contains varying amounts of humus, the latter depending on the ground cover (wood, prairie) and the slope. With the exception of a second paper by Swallow†, nothing of importance on this subject was published until the appearance of Schweitzer's paper.‡ Since the experiments with and the analysis of the soil represent "a typical Missouri soil, made of what professor Swallow has called the Bluff formation," they may be made to apply in a general way to our section. The soil in question rested on a limestone foundation and was at least 12 feet deep. Analyses of four samples of soil, taken from the publication just mentioned, follow. Soil samples nos. 1, 2 and 3 each consisted of topsoil (*a*), taken to a depth of

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* Swallow, G. C. Geological Report of the Country along the Line of the south-western Branch of the Pacific Railroad, State of Missouri. St. Louis. 1859.

† Report of the Board of Agriculture of Missouri. 1881.

‡ Schweitzer, P. Soil, Weather, Field Trials with Corn. Missouri Agric. Coll. Exp. Sta. Bull. 5. 1889.

TABLE J.

	1.a.	1.b.	2.a.	2.b.	3.a.	3.b.	4.
Water at 100° C	1.82	2.92	2.44	2.83	2.31	2.32	4.60
Nitrogen—total......	0.14	0.06	0.13	0.06	0.13	0.07	0.02
Carbon—total........	1.63	0.80	1.57	0.81	1.67	0.68	0.44
Loss by ignition	6.97	7.47	6.92	6.78	7.18	6.86	6.56
Silica................	77.82	74.09	77.20	74.04	77.76	75.36	70.21
Alumina	8.93	10.62	8.02	10.74	8.47	10.10	12.91
Oxide of iron........	3.05	4.19	2.73	3.44	3.24	4.72	6.24
Lime	0.63	0.55	0.63	0.59	0.47	0.42	0.62
Magnesia	0.44	0.38	0.40	0.45	0.29	0.21	0.34
Potassa.............	1.32	1.23	2.54	2.57	1.17	1.13	1.38
Soda................	1.59	1.51	2.05	1.99	1.45	1.45	1.72
Phosphoric acid	0.08	0.09	0.07	0.07	0.06	0.06	0.06
Total...........	100.29	100.13	100.56	100.67	100.09	100.31	100.04

AIR DRIED SOILS.

TABLE K.

	1.a.	1.b.	2.a.	2.b.	3.a.	3.b.	4.
Silica................	83.06	80.06	82.91	79.39	83.77	80.89	75.13
Alumina	9.60	11.48	8.61	11.51	9.13	10.84	13.81
Oxide of iron........	3.28	4.53	2.93	3.69	3.49	5.07	6.68
Lime	0.68	0.59	0.67	0.63	0.51	0.45	0.66
Magnesia	0.48	0.41	0.43	0.48	0.31	0.23	0.37
Potassa.............	1.42	1.33	2.73	2.75	1.26	1.21	1.48
Soda................	1.71	1.63	2.21	2.13	1.56	1.56	1.84
Phosphoric acid......	0.09	0.10	0.07	0.08	0.07	0.06	0.07
	100.32	100.13	100.56	100.66	100.10	100.31	100.04
Insoluble in acid.....	94.73	92.41	95.72	96.10	95.69	96.61	94.34
Portion soluble in muriatic acid.							
Alumina	2.44	3.57	1.74	1.55	0.80	0.57	2.53
Oxide of iron........	1.95	3.04	1.90	2.00	2.61	2.23	2.59
Lime	0.13	0.13	0.39	0.18	0.13	0.15	0.11
Magnesia	0.25	0.24	0.24	0.19	0.19	0.15	0.02
	99.50	99.39	99.99	99.97	99.42	99.71	99.59
Alkalies dissolved....	0.82	0.74	0.57	0.69	0.68	0.60	0.45

IGNITED SOILS.

about 10 inches, and of subsoil (*b*), taken to a depth of 8 inches below the topsoil. The sample marked 4 was obtained from a depth of about three feet, and is a stiff and plastic clay, such as is occasionally found in the Bluff formation in pockets or layers, anywhere and at any depth.

"For the sake of comparison with other soils a second table is calculated for perfectly dry material, and in addition some data given, which are derived from treating the ignited soils with muriatic acid and partially analyzing the solution.

"The composition of these soils is so nearly uniform as to warrant the conclusion that the results of field experiments made upon them cannot be influenced by any supposed difference in their make up."

In the more elevated portions of our territory, such as we find in the vicinity of Jefferson Barracks and from there south to the Meramec, the soil in various places is formed directly upon and from the sedimentary rocks, though here and there seem to be some indications of the presence of drift. In such cases the residual soil is of a rich nature, though the St. Louis limestone, as indicated above, is of a rather pure character. It contains a large amount of black humus but has no great depth, varying in thickness from 1 to 12 inches on the hills and plains. Where the plains are covered by timber, the thickness of the soil layer is somewhat greater than in the open. Immediately below the soil is a layer of slightly disintegrated, much broken up limestone,* through which the roots of the plants penetrate, afterwards to find their way through the fissures of the deeper limestone layers.

The wooded slopes of the upland portion are covered by an accumulation of colluvial soil mixed with some residual soil and which, of slight depth in the higher parts, increases in thickness with the slope, so that in places it forms a layer of from one-half to one foot. Where these slight upland slopes, which nowhere have a large individual area, have been cleared for cultivation, the humus contents soon leach out, forming the unproductive "white lands." As Hilgard* points out, the light color means the scarcity or absence of both humus and ferric hydrate.

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* The question whether some of this material is not of glacial origin remains to be settled. The writer never found other than limestone fragments the flat surfaces of which bore no striations. It was thought that the breaking up of the limestone had occurred under the influence of the liquid components of the soil, materially assisted by the mechanical action of the roots of various plants.

At the base of the cliffs is a notable deposit of soil covering, in many places entirely, the talus, this especially where the loess overlies the limestone. Here the soil is continually being added to by the action of the rills and rivulets which not only brought down residual and colluvial soil from the uplands but themselves aided in the decomposition of the underlying talus. Such lower hillsides ordinarily possess a luxuriant vegetation.

The bottoms on the Missouri side, nowhere very wide, have resulted partly from the deposition, by the Mississippi, of a heavy loam mixed with sand, and partly from the deposition of colluvial soil brought down from the uplands. This soil is rich in lime and in the course of time has been covered by a black humus.

The sandy islands of the Mississippi have the same origin as the sandy stretches immediately bordering the Mississippi on the St. Clair county side and which frequently occur farther inland, the remains of a former river bank, of which we find so striking an example at Cahokia and which, because of the xerophytic character of their ground cover, are readily recognized. In some places on these islands there are large accumulations of clay.

Back of the stretches of sand lies an area the soil of which is composed of heavy loam. It is made up of a mixture of old river deposits covered by the matter deposited by swamps as well as by loess carried down from the bluffs. Its soil is highly calcareous, sharply contrasting with that of the sandy stretches. It is the Yazoo loam† typical of the Mississippi bottoms and highly productive.

The soil at the bottom of the bluffs is partly residual, resulting from the decomposition of the limestone under the influence of vegetation and the elements, and partly colluvial, large amounts of loess being carried down.* Not everywhere along the Illinois bluffs are the conditions the same, as will be shown later. From Stolle southward, the soil partakes far less of the loess character than it does immediately north of this. This is intimately associated with the physiography of the region and the interrelation existing between the course of the river in preglacial times and the position of the Pennsylvanian series.

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* Hilgard, E. Soils. 285. New York. 1907.

† Fippin, E. O., and J. A. Drake. Soil Survey of the O'Fallon Area, Missouri-Illinois. Rept. U. S. D. A., Bureau of Soils. **6**: 815. 1904.

The plateau back of the bluff is covered with a thick layer of loess, containing much lime and iron. The advantages of such a dark soil over a lighter colored one are pointed out by Hilgard.†

Worthen,‡ who was the first geologist to deal with the soil of Illinois, gives the following description of the upland soils:

"The Quaternary deposits, which include the alluvium, loess and drift, are of the greatest economical importance, because the soil is everywhere based upon one or other of these subdivisions, and owes its peculiar features to the character of the strata on which it rests, and from which its organic matters have been derived. All soils consist mainly of the pulverized remains of pre-existing rocks and their fertility depends as much upon the mechanical condition of the material as upon its chemical composition. The conditions under which the drift clays were accumulated were such as to reduce the various rocks from which the material was derived to the condition of a fine sediment that was deposited at the end of that period in the form of a finely pulverized clay, intermingled with silica in the form of sand, magnesia and lime, in such proportions as to form a soil of inexhaustible fertility, under a judicious system of cultivation. To these mineral ingredients have since been added the organic matter derived from the successive growths of animal and vegetable life, that have from year to year matured, and decayed upon the surface, all of which have entered into and gone to make up, the soil in its present condition. This organic matter has furnished the carbonaceous material to which the black color of the soil is mainly due, and the phosphates, the ammonia and other animal substances which have added greatly to its productive qualities.

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* Bowman. *ibid.* 53.

† Soils. 285.

‡ Worthen, A. H. Geol. Surv. Illinois. **1** : 315. 1866.

"The presence of these deposits over nearly the entire surface of the State, gives that uniform character to the soil which forms so marked a feature in its surface geology and makes it one of the finest agricultural regions on the face of the globe. The soils based upon the loess contain a smaller amount of alumina and a larger percent of silica than the ordinary drift soils, and from the porous nature of the subsoil it absorbs water freely, and withstands the extremes of both wet and dry seasons much better than the ordinary clay soils. The calcareous and marly portions of the loess may be used to advantage as a fertilizer on sour and wet clay soils."

Physiography.

The entire section under consideration formed at one time part of an extensive peneplain, the result of a former cycle of erosion at a time when the land stood lower than it does now. As pointed out by Marbut,* it could be reconstructed at the present day by filling up the valleys. This author further points out that by comparison of the stage of development of this peneplain with that reached by another, the geological age of which can be decided by tracing it to its shoreline and determining the age of the rocks which lie upon it or which were deposited just before the uprising, the geological age of the Missouri peneplain can be arrived at. A comparison with the Appalachian region places the completion of the Missouri peneplain not earlier than middle or late Tertiary time. During the glacial period and subsequent to it this plateau underwent first the changes due to the presence of a large and rapidly moving body of water streaming southeastward and carrying with it a large amount of detritus. As the result a valley was scooped out which later was partially filled. The alluvial valley of the Mississippi, near St. Louis, varies in width from four to eight miles, and at no point are its waters circumscribed by the approach of limestone bluffs on either side, though at some places on the Missouri shore the bluffs almost overhang the river.

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* Marbut, C. F. Physical Features of Missouri. Missouri Geological Survey. **10** : 24. 1896.

The river valley during a period when it was covered by extensive, slowly moving, bodies of water, was overlaid by loess. This, occurring after the glacial period, as shown by the drift deposits which in places underlie the loess, was followed by a general uplifting, after which it became subjected to the influences which continue to the present day. The plateau, where not protected by vegetation, was partially denuded from loess, and this, with such soil as might have been formed, carried down the slopes. Smaller streams, finding their origin in precipitation or in local springs, further served to furrow the upper plateau. While on the Missouri side evidences of such action are not so patent to the eye, it is different where the Illinois section is concerned. Here broad, fan-shaped slopes border the hills. This difference is in part due to the geological formation and in part to the fact that the Mississippi in later times hugged the Missouri shore.

The Missouri plateau lies at from 500 to 600 feet above sea-level. It is of a rolling nature, numerous smaller valleys intersecting the land. Here and there are found points of greater elevation than that of the surrounding country, but these are usually of circumscribed area. The surface is partly wooded, partly open and covered by herbaceous growth, grasses forming the major portion. Such prairies, limited in extent and always surrounded by woodland, are always found where the surface is flat or nearly so. A feature common to the woodland and the prairie is the sinkhole. Sinkholes, which take the form of vast funnels, with a diameter of from 10 to 50 yards, originally formed entrances to caves. Frequently, however, they have become partly filled with sediment so that the entrances of the caves have been closed, resulting in the formation of ponds (plate 12,1). James* gives an interesting account of the caves existing under these sinkholes, which is quoted here.

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* James, E. Account of an Expedition from Pittsburgh to the Rocky Mountains. (Thwaites, R. G. Early Western Travels 1748-1846. **14** : 111. Cleveland 1905.)

"Mr. Say descended into one of these, for the purpose of ascertaining the medium temperature below the surface of the earth. This sink opens at the bottom of a deep ravine. It has two apertures near each other, through which water is admitted, and each large enough to afford passage to the body of a man. Within are two chambers from 6 to 12 feet in breadth and 35 feet long. At the bottom of the second chamber is a pool of water rather difficult of access. In this apartment the mercury stood at 60° F., in a shady part of the ravine about 25 feet below the general surface at 75° F." The fact that the temperature in these caves is so much lower is well demonstrated by the fact that several of the larger caves in the city of St. Louis are used as wine-cellars, as for instance one under a portion of Benton Park, the floor of which is 47 feet below the street level and where reigns a temperature of 45° F., varying but little if at all. Similarly, the largest cave in this vicinity, Cliff Cave or Indian Cave, 13 miles south of St. Louis, was at one time used as a cellar by the Cliff Cave Wine Company.

The principal modification of the upland is the ravine, resulting from erosion by perennial streams. It is an open question whether several of these ravines were not formed, in part at least, by solution of the limestone by underground streams, followed by a subsidence of the earth's crust. That this happens rather frequently is shown by Nason* and it is very probable that the ravine at Cliff Cave was formed in exactly this manner, followed by erosion by surface streams.

The Missouri plateau, at least south of St. Louis as far as the mouth of the Meramec River, ends abruptly, the limestone cliffs overhanging the river, the stratification of the St. Louis limestone being almost horizontal at this point (plate 15, 1). Thus a bluff is formed which affords plants but a slight foothold especially since the erosion by the river in earlier days left numerous concave surfaces. At the base of these bluffs is a small amount of talus, together with colluvial soil brought from the plateau. This permits the growth of numerous shrubs and herbs. Here and there small springs issue from the face of the bluffs. Noticeable is the effect of the small creeks upon the St. Louis limestone where it borders the river. A miniature cañon and numerous small terraces are formed, the limestone apparently being removed according to its stratification (plate 15, 2).

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* Nason, F. L. A Report on the Iron Ores of Missouri. Missouri Geological Survey. 2 : 90. 1892.

The Mississippi bottoms on the Missouri side are not wide, though in places they extend a mile or more. Especially in early summer they are subject to overflow and the inhabitants are forced to dwell in houseboats, for the same reason that the occupants of the lower portions of the American Bottom elect to build their homes on stilts. The river itself derives its distinguishing features from the Missouri,* such as turbid waters, shifting bars and channels, rapid erosion of alluvial banks and extensive accretions, building up and removing islands, tow-heads and battures with great rapidity (plate 11).

Opposite St. Louis, in St. Clair and Madison counties, lies the most northern portion of the most extensive tract of valley country east of the Mississippi, known as the American Bottom (plate 11). Extending from the mouth of the Kaskaskia river to the Piasa hills, four miles above the mouth of the Missouri, it occupies a strip some 80 miles long with an average width of 4 miles. It represents older as well as more recent river deposit. This, in our section, is in places covered by the rich mud of the Missouri combined with a large amount of vegetable matter brought down by the Mississippi. Close to the river its level is but slightly elevated above that of the latter; farther inland its surface rises several feet. Where the land is low and mainly consists of clay it constitutes what is known as the "wet bottom," other, higher places, where the soil is sandy and which largely lack the recent river deposit, are designated as "dry bottom." The latter is met with on the west side of Horseshoe Lake and in the vicinity of Cahokia. Here and there woods occupy the land and formerly did so to a greater extent, but at the present time they have largely been cleared away. As is to be expected, sloughs everywhere encroach upon the land-surface, and swamps, the result of slowly draining lakes, are plentiful. Both in the lower part of the American Bottom and close to the bluffs are a number of lakes which receive the water from the numerous creeks descending from the Illinois plateau.* The lakes of the American Bottom (plate 20) may be readily interpreted as being parts of the old bed of the river, isolated through a series of cut-offs. The origin of such lakes, which are typical of the swamps of all gulf rivers but especially of the Mississippi, lies in the winding course of rivers through their flood plains. As pointed out by Marbut† these windings or *meanders* are primarily caused by some obstruction which deflects the current against one of the banks, resulting in the excavation of this bank and deposition on the other. This action causes a slight bend of the river bed. Since the process continues there finally comes about, through deposition on the inner curve and excavation of the outer curve, a deep bend, known as an "ox-bow." The size and length of existence of these ox-bows is determined by various factors, among which the greater length of the stream, and consequent lower gradient and decreased velocity, play important parts. In a meander of great length the difference in water level on opposite sides of the narrow neck will be appreciable and result in the cutting of a small ravine backward from the lower side. This ravine, in times of flood, becomes enlarged and soon forms a new channel for the entire river, forming a cut-off. It may be noted that for each river there appears to be an average width of meander before the cut-off is made. This width, for the Mississippi, is about 6 miles, but is sometimes exceeded, as at New Madrid. However, it seems but reasonable to suppose that in earlier days when the volume of water carried by the river was greater, and the material coarser (the transporting power of a current varies as the 6th power of the velocity), and erosion easier (Marbut, p. 95) the size of the ox-bows was correspondingly greater. Under this assumption we can interpret the lakes of the American Bottom opposite St. Louis as the results of a single cut-off. A comparison of the St. Louis sheets of the U. S. Geological Survey of November, 1893, and April, 1904, shows the probable existence at one time of an ox-bow fully 12 miles across. Thus the most northern part of the cut-off is formed by Horseshoe Lake; Spring Lake and Grand Marais Lake[*] form the middle portion, while Cahokia Lake forms the south bend. In the years which elapsed between the surveys for the two maps (1888-1903), great changes took place, especially as far as the outlines of the lakes are concerned. The 1904 map shows that their area has been greatly reduced. Horseshoe Lake has retreated from its former western boundary; Indian Lake has become a mere swamp, and Spring Lake occupies now but about one-twentieth of its original surface, limited to the most eastern portion, the remainder being swamp. All connection with Pittsburg Lake has been lost. Pittsburg Lake remains practically as it was except that here and there it has retreated and portions of it have been diked. Of Cahokia Lake but a small part of the northeastern portion remains as open water, and for the greater part is a mere swamp through which flows Prairie du Pont Creek.

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* Simpson. Rep. U. S. Engineers. **2^2 :** 472. 1875. See Todd, J. E. Formation of Quaternary Deposits. Missouri Geological Survey. **10 :** 192. 1896.

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* For the hydrography see Bowman, I. Water Resources of the East St. Louis District. Ill. State Geol. Surv. Bull. 5. 1907; and Helm, E. G. The Levee and Drainage Problems of the American Bottoms. Journ. Assoc. Eng. Soc. **35** : 99. Sept. 1905.

† Marbut, C. F. The Physical Features of Missouri. Missouri Geological Survey. **10** : 95. 1896.

Striking features of the American Bottoms are a number of elevations, known as "Indian Mounds," on which subject it is of interest to quote Worthen[†] at length.

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[*] Designated Pittsburg Lake in the 1904 map. This is the name now generally given to this lake, the old name being occasionally used by the older of the descendants of French settlers. It may be noted here that a portion of the lake, immediately adjoining the bluff, separated from the main body of water by the bridge of the Illinois and St. Louis railroad and divided into two portions by the bridge of the St. Louis, Alton and Terre Haute railroad, is generally known as Bluff Lake. This name, however, properly belongs to the lake immediately south of Falling Spring.

[*] Worthen, A. H. Geol. Surv. Ill. **1** : 314. 1866.

"A considerable portion of this bottom is below the high water level of the Mississippi, and is therefore subject to periodical inundations from the annual overflow of the river, while other portions are above high water mark and owe their origin to some other cause than the existing river. It seems probable indeed that a considerable portion of the area now comprised in this bottom was originally occupied by deposits of drift clay and loess, that were deposited after the valley was scooped out of the sub-carboniferous limestones, filling the valley to the height of 50-60 feet above its present level, and were in part removed by subsequent erosion during the period of elevation and drainage that succeeded the drift epoch. In proof of this there are many elevations scattered over the surface of this bottom, locally known as "mounds," the formation of which have generally been referred to human agencies. These elevations vary in height from ten to sixty feet or more above the level of the surrounding bottom and when carefully examined are found to consist of drift clay and loess, remaining *in situ* just as they appear along the river bluffs where similar mounds have been formed in the same way by the removal of the surrounding strata by currents of water. We had an opportunity of seeing a good section of the large mound in the upper part of the city of St. Louis exposed by digging into the upper end of the mound for material to be used in filling adjacent lots. It was found to consist of about fifteen feet of common chocolate brown drift clay at the base, which was overlaid by thirty feet or more of the ash-colored marly sands of the loess, the line of separation between the two deposits remaining as distinct and well defined as they usually are in good artificial sections in the railroad cuts through these deposits.

"Hence we infer that these mounds are not artificial elevations raised by the aboriginal inhabitants of the country, as has been assumed by antiquaries generally, but on the contrary, they are simply outliers of loess and drift, that have remained as originally deposited, while the surrounding contemporaneous strata were swept away by denuding forces. They are not found to occupy any fixed relative position in relation to each other, or to have any regularity of size or elevation, and hence antiquarians appear to have inferred that they were raised simply to serve as burial places for the dead. But the simple fact that they were used for this purpose by the aborigines, which seems to be the main argument relied on as a proof of their artificial origin, seems to me entirely inadequate to sustain such a conclusion, and they were perhaps only selected by them for this purpose on account of their elevated position, for the same reason that they selected the highest point of a bluff, in preference to any lower point, to serve as the last resting place for the earthly bodies of their relatives and friends. I have very little doubt that many of the so-called Indian Mounds, in this State at least, if carefully examined, would prove to be only natural elevations produced by the causes above named."

The American Bottom is bordered by the Illinois bluffs. Because of the geological formation, these, south of Stolle, are of the same nature as the bluffs on the Missouri side. North of Stolle the bluff disappears and gives place to broad, fan-shaped slopes. The ordinarily flat, sometimes undulating tracts, which compose the Illinois plateau, situated from 500 to 600 feet above sea-level, are divided by narrow strips of woodland bordering the creeks and rivers and are covered by a rich soil. The water table of the country is but little inclined and the streams have but a moderate descent. Owing to this, the decaying vegetable matter is not carried off and the rainwater becomes stagnant, resulting in unhealthful conditions. Sinkholes are frequent. Near the bluffs often occur strips of woodland.

THE FLORA.

PLANT SOCIETIES.

The plant societies which are here analyzed successively from the table-land on the Missouri side of the Mississippi River, to the table-land on the Illinois side, agree very closely with those indicated by Daniels,* the component species, for the greater part at least, being also identical with those in the region studied, the differences which exist being evident from the following detailed analysis.

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* Daniels, F. P. The Flora of Columbia, Missouri and Vicinity. The University of Missouri Studies. Science Series. 1^2. 1907.

Regional Associations.

THE MISSOURI PLATEAU.

The principal feature of the plateau on the Missouri side of the river is the oak forest formation. Though a large portion of this plateau, for agricultural purposes, has been denuded of its tree growth, there still remain comparatively extensive tracts where the flora is hardly, if at all, influenced by human agency. The woods occupy a belt, in places several miles in width, bordering the cliffs on the western shore of the Mississippi (plate 10). The area covered by them is mainly of a rolling character, with here and there flat surfaces varying in extent. These are ordinarily free from tree growth and are covered by grasses and herbs. Where these plains are of a comparatively large extent, as occasionally is the case, there is a corresponding change in the ground cover, resulting in a distinct prairie formation, not differing materially from that found on the Illinois plateau.

Intermediate between the forest formation and the prairie formation is the shrub formation. This, as is characteristic of temperate regions as contrasted with conditions prevailing in the tropics, always forms the transition between the forest and the prairie formation. Naturally, numerous modifications, principally due to physiographical conditions, can be noted. So in the forest formation the flora of the dry hilltops varies from that of the lower slopes. Limestone glades offer a flora distinctly their own, sharply contrasting with that of the well drained, shaded hillsides. Owing to the sheltered conditions, the warmer air currents, the deposition of seeds from the plateau through the agency of wind and water, the uphill movement of the talus flora, and the practically continuous supply of water through underground drainage and various other conditions, those of the ravines which are topographically older are rich in species and combine many of the features of the upland and lowland flora. Hill crests further serve to modify conditions, as do the sinkholes, which may be either dry or wet, dependent upon changes in the earth-crust indicated previously.

Forest formation.

In the deciduous forests which cover the larger portion of the Missouri plateau (plate 10), the oak is dominant. The most abundant as well as the most frequent species is the black oak, *Quercus coccinea tinctoria.* Associated with it are *Q. imbricaria, Q. Muhlenbergii, Q. nigra, Q. rubra* and *Q. Schneckii,* the smaller *Q. stellata* forming an important part of the undergrowth. Interspersed with the oaks are hickories, *Carya alba, C. porcina odorata* and *C. tomentosa.** Other species which go to make up the forest are *Juglans cinerea* and *J. nigra, Ulmus fulva, Sassafras officinale, Acer saccharinum, Fraxinus americana, Morus rubra* and *Diospyros virginiana.* Though the tree stems are placed at a considerable distance from each other, their foliage forms a compact roof, allowing but little light to penetrate. Measurements made during the first days of July, about the noon hour, showed the intensity of the diffused light in the forest to be from 8 to 10% of that of the total daylight, the sky being free from clouds. As a result of the low intensity of the diffused light there occurs but little undergrowth of a shrubby nature, though specimens of *Quercus stellata, Ceanothus americanus, Rhus copallina* and *R. glabra, Prunus serotina, Pyrus coronaria, Cornus asperifolia* and *C. florida, Sambucus canadensis* and *Viburnum prunifolium* as well as of *Diospyros virginiana* are met with. Also as a result of the small amount of light the shrubs do not form thickets here but occur as more or less isolated individuals. The ground cover consists largely of biennials and perennials which develop their root leaves either before the leaves of the deciduous trees have appeared or before they have attained their full development;†

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* Illustrated by Trelease in: Juglandaceae of the United States. Rept. Mo. Bot. Gard. 7 : 25. 1896.

† Biennials, as shown by Wiesner in his Der Lichtgenuss der Pflanzen, commence their development during a period of decreasing light intensity, i. e. during the latter part of the year and, after a period of rest, resume growth. Perennials, possessing a store of food material, require less light than do annuals. This explains the predominance, in our woods, of perennials such as *Hydrastis, Sanicula, Spiraea, Arisaema,* etc. In woods many of the annuals have made their appearance before the leaves of the trees are unfolded.

yet nowhere are these plants abundant, though most of them are frequent.*

The spring flora is the most numerous and diversified. Among the Ranunculaceae *Delphinium tricorne* and *Thalictrum purpurascens* are the more important. *Podophyllum peltatum*, the May apple, essentially gregarious, occupies large patches here and there. *Viola palmata* and *V. palmata cucullata* occur with great frequency, as do *Oxalis stricta*, *O. violacea* and *Geum album*, though the latter is never abundant, single plants or plants in twos and threes being found in the shelter of tree trunks. Sometimes *Trifolium procumbens* finds its way into the woods, though it properly belongs on the grassy slopes encountered here and there, where it sometimes takes almost complete possession. *Dodecatheon Meadia* attracts immediate attention on account of its delicate pink blossoms pendent from a slender flower stem, its bright green rosette contrasting sharply with the light brown of the decaying oak-leaves which everywhere cover the ground to a depth of several inches. Other species occurring during the spring in these open woods and readily noted because of the number of individuals are *Potentilla canadensis*, *Spiraea Aruncus*, *Heuchera americana*, *Daucus Carota*, *Sanicula marylandica*, *Thaspium aureum* and *T. aureum trifoliatum*, *Cacalia atriplicifolia*, *Krigia amplexicaulis*, *Senecio aureus*, *Phlox divaricata*, *Triosteum angustifolium* and *T. perfoliatum*, *Blephilia ciliata*, *Brunella vulgaris*, *Sisyrinchium albidum* and *S. anceps*, and *Hypoxis erecta*. *Polygonatum giganteum* and *Smilacina racemosa*, always gregarious, occur with frequency. Several species of *Carex* are found, especially *Carex laxiflora latifolia*, which persists throughout the year. The spring grasses are mainly *Agrostis scabra*, *Eatonia pennsylvanica* and *Melica diffusa*. Other spring plants encountered are *Polemonium reptans*, *Cynoglossum virginicum*, *Physalis subglabrata*, *Pedicularis canadensis* (parasitic on *Achillea Millefolium*), *Pentstemon pubescens*, *Aphyllon uniflorum*, *Cypripedium pubescens*, *Camassia Fraseri*, *Trillium recurvatum* and *T. sessile*, and *Botrychium virginianum*.

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* The terms "frequent" and "abundant" here are used in the sense indicated by Pound and Clements, The Phytogeography of Nebraska. 2 ed. 1900.

During the summer the climbers become evident, *Menispermum canadense* and *Ampelopsis quinquefolia* especially, while long and slender, almost etiolated shoots of *Humulus Lupulus* are frequently met with, as are shoots of *Smilax herbacea* and *S. hispida.* Among the herbaceous plants which during the summer are chiefly in evidence must be mentioned *Anemone virginiana. Cerastium nutans* and *C. viscosum,* already present in spring, persist throughout the summer and autumn. *Oxalis cymosa,* readily distinguished from *O. stricta* by its greater stature, dense pubescence of the stem, its runners, the greater number of flowers in the inflorescence and the failure of the pedicel with the ripening fruit to bend at a sharp angle, makes its appearance during the early summer months. Several Leguminosae occur, chiefly *Amphicarpaea monoica, A. Pitcheri, Desmodium cuspidatum, D. marilandicum* and *D. rotundifolium, Lespedeza reticulata* and *L. violacea.* Here and there the graceful stalks of *Eryngium yuccaefolium,* which occurs in patches, can be seen. *Antennaria plantaginifolia,* now as well as earlier, is in evidence wherever the most adverse conditions prevail. Other Compositae which make their appearance about this time are *Actinomeris squarrosa, Cnicus altissimus, Elephantopus carolinianus, Echinacea purpurea, Helianthus occidentalis, Heliopsis laevis, Lactuca ludoviciana, Prenanthes racemosa,* and *Verbesina helianthoides. Apocynum cannabinum* forms patches here and there. *Asclepias purpurascens* is represented by isolated individuals. Also in evidence are *Echinospermum virginicum, Gerardia tenuifolia, Phryma leptostachya, Monarda fistulosa, Scutellaria versicolor, Phytolacca decandra, Polygonum virginicum, Acalypha virginica* and the omnipresent *Euphorbia Preslii.* Frequent is *Tradescantia virginica. Juncus tenuis* covers the paths. Among the grasses *Asprella Hystrix,* several species of *Muhlenbergia, Panicum filiforme* and *Uniola latifolia* are the principal representatives. Several ferns have made their appearance by this time, especially *Adiantum pedatum, Aspidium acrostichoides* and *Woodsia obtusa. Pteris aquilina* forms large patches.

The approach of fall is heralded by the blooming of numerous Compositae. Of these the more important are, besides

Erechtites hieracifolia, Aster azureus, A. cordifolius and *A. turbinellus, Eupatorium ageratoides, Solidago radula, S. rigida* and *S. speciosa.* From July or August on *Vernonia noveboracensis,* occurring in clumps, has been in full bloom. At this time too, the Labiatae form an important part of the ground cover, especially *Monarda fistulosa, Pycnanthemum muticum pilosum* and *P. linifolium.* These occur ordinarily in small clumps composed of but a few plants.

Dry hilltops.

The oaks occurring here, besides *Quercus coccinea tinctoria,* are *Q. alba, Q. Muhlenbergii, Q. nigra, Q. stellata* and *Q. Schneckii* which, with *Carya alba, C. porcina odorata, C. tomentosa* and *Sassafras officinale,* form the main aspect. The trees being farther apart than in the typical oak forest and often even isolated, an opportunity is offered for the growth of numerous species ordinarily not found in the latter formation, including trees, shrubs and herbs. Among the trees is *Robinia Pseudacacia* of which isolated specimens are met with here, as is the case with *Prunus serotina* which here perhaps reaches its greatest development. Though of this species a single large tree is sometimes found here, it ordinarily forms thickets, alone or with *Rhamnus caroliniana, Rhus copallina, R. glabra* and *Viburnum prunifolium.* It is to be noted that the herbaceous plants on the dry hilltops are chiefly those whose seeds are capable of being transported by wind.

The spring flora is not as characteristic in this location, and consists of *Anemonella thalictroides, Ranunculus fascicularis* and *Capsella Bursa-pastoris,* together with *Viola pedata,* which here reaches its highest development and of which sometimes the variety *bicolor* is found. The rosette character of the spring flora is further emphasized by plants of *Erigeron bellidifolius, Gnaphalium polycephalum, Androsace occidentalis, Verbascum Thapsus, Verbena Aubletia* and *Plantago patagonica aristata.* Specimens of *Comandra umbellata, Sisyrinchium albidum, S. anceps* and *Nothoscordum striatum* occur with varying frequency.

During the summer *Helianthus occidentalis, Rudbeckia hirta, Solidago rigida, Verbesina helianthoides, Lobelia in-*

flata and *L. leptostachys*, *Apocynum androsaemifolium*, *Asclepias tuberosa* and *A. verticillata*, as well as *Verbascum Thapsus*, *Sabbatia angularis*, *Cunila Mariana* and *Monarda Bradburiana* are prominent, while in late summer and early fall the Compositae seem to occupy the entire space, though *Monarda punctata* remains in bloom till late in the year. The autumn vegetation is made up mainly of *Aster patens*, *A. turbinellus*, *Helianthus occidentalis*, *Rudbeckia triloba* and *Solidago rigida*. In summer *Juncus tenuis*, *Carex oligocarpa*, *Agrostis alba*, *Danthonia spicata*, *Festuca tenella*, and *Panicum depauperatum* are everywhere. Two ferns, *Aspidium marginale* and *Pteris aquilina*, are found from spring till autumn.

Limestone glades.

Limestone glades are rather frequently occurring areas of small scope, ordinarily of great elevation, where the surface is but little inclined. As a result of these conditions the greater part of the soil formed is washed away by heavy rains and the limestone retains but a scant covering of soil. Though the heavy rains are sufficient to carry off most of the soil, the drainage of limestone glades appears to be poor. Especially in spring time the soil is exceedingly wet, the water draining away but slowly, probably through fissures in the limestone by which the water is carried off to larger underground channels, and lost to the plants of the limestone glade. As a result, such localities have a limited flora at best. They are usually covered with an excessive growth of *Sassafras officinale*, represented by numerous small trees, probably suckers, originating from the few older trees occurring there. The reason that so few of the latter are met with in similar localities lies probably in the fact that the development of a root system is so modified by the underlying limestone that the trees can not secure a sufficient foothold to withstand the early summer storms, occurring at a time when the ground is greatly softened. Evidence of this is found in the stumps and rotting sassafras logs, so often met with in limestone glades. Besides sassafras there is very little woody growth, it being limited to *Rhamnus lanceolata* and *Diospyros vir-*

giniana, specimens of *Rosa blanda* and *R. humilis* not being uncommon.

In spring the ground cover is composed of occasional specimens of *Delphinium tricorne, Arabis ludoviciana, Draba cuneifolia, Arenaria patula, Polygala verticillata, Astragalus mexicanus, Houstonia purpurea, Camassia Fraseri, Nothoscordum striatum* and others. *Cacalia tuberosa* makes its appearance in the spring, as does *Silphium integrifolium*, to remain throughout the summer and fall. *Opuntia Rafinesquii* and *Agave virginica* are typical here. An excellent illustration of the latter species in this locality is given by Miss Mulford.* The grasses ordinarily met with are *Bouteloua racemosa, Danthonia spicata* and *Panicum depauperatum.*

The early summer presents the largest number of species. The principal plants are *Silene antirrhina, Ascyrum Crux-Andreae, Hypericum nudicaule, Crotalaria sagittalis, Lespedeza capitata, Petalostemon violaceus* and *P. candidus, Gaura biennis, Polytaenia Nuttallii, Pimpinella integerrima, Thaspium aureum*, and *Blephilia ciliata.* In autumn these are largely replaced by Compositae, such as *Aster laevis* and *A. oblongifolius, Eupatorium altissimum, Solidago petiolaris* and *S. rigida. Gerardia tenuifolia* is frequent at this time as are *Andropogon furcatus* and *A. scoparius. Pteris aquilina* is common throughout the year.

Sinkholes.

As indicated above, sinkholes in the deciduous forest may be either dry or wet. Where dry, i. e. where a drainage system is present, they harbor plants which are usually referred to as appreciating a well drained soil (plate 13). *Hydrastis canadensis, Oxalis violacea, Polygonatum giganteum, Smilacina racemosa, Arisaema Dracontium* and *A. triphyllum* occur here in greatest abundance. They form the most important portion of the flora of sinkholes during the spring and summer months, together with *Sanicula marylandica, Spiraea Aruncus* and occasional ferns such as *Adiantum pedatum, Aspidium acrostichoides*, and *Cystopteris fragilis.*

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* Mulford, A. I. A Study of the Agaves of the United States. Rept. Mo. Bot. Gard. **7.** *pl. 26.* 1896.

It is to be noted that *Hydrastis canadensis* forms large patches to the exclusion of all other species, as is true to some extent of *Arisaema triphyllum, Polygonatum giganteum* and *Smilacina racemosa.* *Oxalis violacea* ordinarily occurs singly. Occasionally *Passiflora lutea* is met with. The aerial portion of most of the plants just mentioned dies off in early fall, leaving the sinkhole comparatively bare. This forms a great contrast with the sinkholes occurring in the open plain. Here again dry and wet sinkholes are to be considered. The dry sinkhole in the plain is usually surrounded by shrubbery, composed chiefly of *Euonymus atropurpureus, Staphylea trifolia, Rhus Toxicodendron, Pyrus coronaria, Sambucus canadensis* and *Ribes gracile,* through which *Vitis cordifolia* twines. Occasionally a few oaks or hickories or a solitary *Platanus occidentalis* overtop the shrubbery, evidently a survival from a period when the drainage of the sinkhole was temporarily interrupted. The inner, upper portion of the sinkhole usually accommodates numerous smaller, stunted specimens of *Ribes gracile* together with briars and brambles. The central portion of the sinkhole is ordinarily bare, the water which at each rain rushes past to escape through the fissure, sometimes as much as two feet in diameter, preventing the establishment of any plants. On the sides are found occasional specimens of *Arisaema Dracontium, Arisaema triphyllum* and *Smilacina racemosa.* Neither *Hydrastis canadensis* nor *Commelina virginica,* so frequent in sinkholes in woods, is ordinarily met with here. Nor are the ferns which frequent the latter encountered. On the other hand, *Passiflora lutea* is far more common. When, as frequently happens, one of the edges of a sinkhole in the open plain is bare of shrubbery, *Hypericum Drummondii, Desmodium Dillenii* and *Eryngium yuccaefolium* are found during the summer months.

The wet sinkhole in woods, more familiar as a wooded pond, has a flora distinctively its own.

Wooded ponds.

Here and there the forest formation is interrupted because of small ponds which are the result of the obstruction of the drainage of sinkholes. As a result, not only is the sinkhole filled with water but the latter also accumulates over the ground which immediately surrounds the sinkhole and which ordinarily has a slight slope towards it. It is evident that the water will continue to encroach upon the ground till an equilibrium shall have been established between the water supply and the evaporation. Ordinarily the wooded ponds are therefore quite shallow with the exception of an area of great depth at or near the center. Hence we never find the central portion occupied by plants whose roots penetrate the mud, but by floating forms only.

Wooded ponds permit the growth of the more water-loving species of oak, occasionally associated with specimens of *Platanus occidentalis* (plate 12, 1). The larger amount of light permits the existence of numerous shrubs which, however, belong to comparatively few species, *Staphylea trifolia* being prominent at some distance from the water, where *Cephalanthus occidentalis* is abundant. *Vitis cordifolia, Vitis riparia, Rhus Toxicodendron, Smilax herbacea* and *S. hispida* are the principal creepers.

The herbaceous flora is a distinct rosette formation, the xerophytic character possibly being due to too great an amount of water in the soil, interfering with the necessary life processes. This is borne out by the opinion expressed by Nillson* quoted by Coulter.† The principal components are *Arctium Lappa minus, Solidago Drummondii, S. canadensis, S. ulmifolia, Erigeron canadensis* and *Brunella vulgaris.* As to the hydrophytic flora, *Heteranthera limosa* and *Pontederia cordata* together with *Jussieua repens* on the one hand, and *Lemna perpusilla* and *Wolffia punctata* on the other, are the principal species. The presence of large quantities of *Riccia natans* must also be mentioned.

In sharp contrast to the wooded pond stands the open pond, i. e. the wet sinkhole in the field. All woody plants are absent with the exception of an occasional specimen of *Cephalanthus occidentalis.* The main flora around the wet sinkholes consists of grasses and sedges, chiefly *Cyperus acuminatus* and *C. erythrorhizos*, *Dulichium spathaceum*, *Eleocharis acicularis*, *Scirpus lacustris*, *Glyceria nervata* and *Leersia oryzoides*. Ordinarily the wet sinkholes in the field are of small depth, the soil from the surrounding slopes being washed down in great quantities, not being retained by roots, etc, as in the case of a wooded pond. Hence the majority are sufficiently shallow to accommodate species of *Sagittaria*, especially *S. variabilis*. Algae occur here in large quantities, as they do in the wooded ponds or in the bodies of water in the American Bottom.

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* Nillson, H. Einiges ueber die Biologie der schwedischen Sumpfpflanzen. Bot. Centralbl. **76** : 9. 1898.

† Coulter, S. M. An Ecological Comparison of some Typical Swamp-Areas. Rept. Mo. Bot. Gard. **15** : 39. 1904.

Shaded hillsides.

The well drained, shaded hillsides offer optimum conditions to the plants of the region studied. Not only do they possess excellent drainage but soil is continually washed down from the higher slopes while at the same time the humus locally formed is, for the greater part at least, retained. The oaks, while still dominant, are not arranged as densely as in the dry, open wood, and shrubs are abundant. The species of oak are the same as indicated for the last named locality (*Quercus coccinea tinctoria*, *Q. imbricaria*, *Q. Muhlenbergii*, *Q. nigra*, *Q. Schneckii*, *Q. stellata*), but they are interspersed with numerous specimens of *Ulmus fulva*. *Cercis canadensis* is prominent. The principal shrubs are *Ptelea trifoliata*, *Euonymus atropurpureus*, *Ceanothus americanus* and *Rhamnus lanceolata*, with an undergrowth of smaller shrubs such as *Rhus glabra*, *Rhus canadensis* and *Symphoricarpus vulgaris*. *Ampelopsis quinquefolia* climbs the larger stems and *Vitis riparia* and *Rhus Toxicodendron* twine among the bushes. The spring and the fall flora again are the most prominent. *Hydrastis canadensis*, *Delphinium tricorne*, *Podophyllum peltatum*, *Viola palmata* and *V. palmata cucullata*, *Geranium maculatum*, *Geum album*, *Heuchera americana*, *Sanicula marylandica*, *Polygonatum giganteum* and *Smilacina racemosa* are the most prominent spring species. *Trillium recurvatum* and *T. sessile* are not infrequent. *Claytonia virginica*, wherever an open space occurs, blooms in profusion during March and April. It is to be noted that the blooming season of this plant may be interrupted, the interruption sometimes lasting a month or more. This was especially to be noticed during the spring of 1907, in which year the unusually warm weather during February and March, followed by a cold period with killing frosts, brought about a second flowering period of *Claytonia virginica* during May.

In the early summer an occasional specimen of *Anemone caroliniana*, very rare on the Missouri side of the section studied, is met with. Not abundant is *Aralia quinquefolia. Ranunculus fascicularis* is not infrequent. The principal sedges and grasses are several species of *Carex*, especially *C. laxiflora latifolia*, *Melica diffusa* and *Muhlenbergia diffusa.* In drier places *Hypoxis erecta* is frequent.

During the fall the Compositae give the tone to the whole, principally *Eupatorium ageratoides* and *E. altissimum*, *Rudbeckia triloba*, *Solidago ulmifolia*, *Verbesina helianthoides* and *Vernonia noveboracensis*, though *Pycnanthemum linifolium* is frequent.

Ravines.

The flora of such small ravines as open into the valley of the river combine with their typical mesophytic flora not a few of the xerophytes which have wandered in from the adjoining bluffs, as well as the hydrophytic flora derived from springs and hillside creeks, thus forming a very striking modification of the deciduous oak forest. Owing to the underground drainage, only moisture-loving oaks such as *Quercus alba*, *Q. coccinea tinctoria*, *Q. macrocarpa*, *Q. Muhlenbergii* and *Q. rubra* occur here. They, with *Sassafras officinale*, *Acer saccharinum*, *Juglans cinerea*, *J. nigra*, *Carya amara* and *C. olivaeformis*, are the principal trees. The smaller trees and shrubs as a rule never form thickets but are solitary or subsolitary. These are *Asimina triloba*, *Ceanothus americanus*, *Cercis canadensis*, *Hydrangea arborescens*, *Viburnum rufotomentosum* and *Lindera Benzoin.*

Herbaceous growth is well represented throughout the seasons. In spring the Ranunculaceae are numerous, the principal species being *Actaea alba*, *Anemone virginiana*, *Ranunculus abortivus*, *R. recurvatus*, *R. repens* and *R. septentrionalis.* A little later, *Impatiens fulva*, properly belonging on the lower hillsides, makes its appearance bordering the creeks. *Oxalis stricta* is frequent as is *Sanicula marylandica* and *S. marylandica canadensis.* Not infrequent, but never abundant, are orchids, especially *Cypripedium pubescens.* The same is true for *Arisaema Dracontium* and *A. triphyllum, Asplenium ebeneum* and *Botrychium virginianum.* The latter plant occurs especially where there are large fissures in the limestone rocks partly filled with colluvial soil. This plant,—and the same is true for *Ophioglossum Engelmanni,*—delights in constant moisture, and the limestone fissures, the soil in which is ordinarily covered with moisture-retaining mosses, offer an excellent location. However, since in the immediate vicinity of the Mississippi river the dip of the limestone is but slight, crevices adapted to the growth of the two species just mentioned are not numerous. Farther west, especially, in our territory, in the bluffs on the east side of the Meramec river, where the influence of the Ozark uplift is more pronounced, the dip allows the existence of numerous pockets adapted to the needs of both *Botrychium virginianum* and *Ophioglossum Engelmanni.* Mosses are abundant, covering the ground and running over stones. Most frequent are *Amblystegium serpens* and *A. varium, Physcomitrium turbinatum* and *Mnium cuspidatum.*

With the advent of summer those species which are typically vernal-flowering disappear. Such are *Sanguinaria canadensis* and *Claytonia virginica.* On the other hand, many which during the spring were present as rosettes only now begin to bloom, among them the later-flowering species of Ranunculus, such as *R. repens. Hydrophyllum canadense, Solanum nigrum* and *Seymeria macrophylla* make their appearance. Noticeable is the presence of *Passiflora lutea* and of *Blephilia hirsuta* which takes the place of *B. ciliata* occurring in the dry, open wood. Similarly *Cassia nictitans* replaces *C. marilandica.* During the summer several additional mosses become evident, principally *Cylindrothecium Macounii* and *Ditrichum pallidum. Cladonia pyxidata* is the only lichen occurring with frequency. At the mouth of springs *Marchantia polymorpha* is regularly met with.

In the fall the herbaceous plants are represented largely by Compositae, with the exception of specimens of *Actaea alba,* the fruit of which is in evidence during the early part of the autumn, and *Galium Aparine, G. circaezans, G. concinnum* and *G. pilosum,* which continue to clothe the banks and shelves, the former on the lower hillside, the latter on the upper. Among the Compositae, *Eupatorium altissimum* and *Solidago latifolia* are most prominent. A moss *Atrichum angustatum,* makes its appearance at this time.

A special feature of a ravine is the creek which finds its way through it. In early spring filled to overflowing and even frequently inundating its banks, during the summer and fall it merely serves as an outlet for the underground drainage which never fails though it may be reduced to a minimum. Algae, especially *Cladophora glomerata,* the latter species even through the winter, are present during the entire year. Besides Bacillariaceae and Desmidiaceae, one meets with *Gonium pectorale.* A species of *Phormidium* covers the stones. In summer and fall *Euglena acus* and *E. viridis* are frequently met with.

Creek banks.

The trees occurring on the creek banks are *Acer saccharinum, Fraxinus americana, F. viridis, Celtis occidentalis, Morus rubra, Ulmus americana, Platanus occidentalis, Betula nigra, Carpinus caroliniana, Quercus alba, Q. coccinea tinctoria,* and *Q. macrocarpa.* The smaller trees and shrubs which find a place here are *Ptelea trifoliata, Rhamnus lanceolata, Staphylea trifolia, Physocarpus opulifolius, Prunus americana, P. serotina, Sambucus canadensis,* and *Viburnum Lentago,* together with *Rosa setigera* and *Hydrangea arborescens,* the latter species forming extensive groups. Climbers such as *Ampelopsis quinquefolia, Cissus Ampelopsis, Vitis cinerea, V. cordata* and *V. riparia* as well as *Rhus Toxicodendron* are everywhere, as are the shoots of *Smilax herbacea, S. hispida* and *Tecoma radicans,* the latter at least in the more open places.

The spring flora consists largely of rosette forms, the Ranunculaceae and liliaceous group yielding the largest contingent. The principal species are *Delphinium tricorne,* *Hydrastis canadensis, Ranunculus abortivus, R. septentrionalis, Podophyllum peltatum, Capsella Bursa-pastoris, Claytonia virginica, Geranium maculatum, Oxalis stricta, Callitriche deflexa Austini, Circaea Lutetiana, Chaerophyllum procumbens, Sanicula marylandica canadensis, Senecio aureus, Phlox divaricata, Ellisia Nyctelea, Monarda fistulosa, Nepeta Glechoma, Erythronium albidum, Trillium recurvatum* and *T. sessile, Uvularia perfoliata, Arisaema Dracontium* and *A. triphyllum*, two or three species of *Carex, Elymus striatus* and *Poa pratensis*, and numerous excellent specimens of *Adiantum pedatum* and *Cystopteris fragilis.*

While most of these species are present during the summer, they become less striking owing to the appearance of numerous other species, especially of Compositae and Labiatae. Among the former are *Actinomeris squarrosa, Coreopsis tripteris, Eupatorium purpureum, Helenium nudiflorum, Rudbeckia laciniata* and *Xanthium canadense.* Striking are the masses of *Echinocystis lobata* and *Sicyos angulatus* which become evident about this time on the lower banks, shortly to form an almost impenetrable curtain. Autumn does not bring any marked changes on the creek banks, very few species being added.

Prairies.

The prairies which cover limited areas of the Missouri plateau owe the peculiar character of their vegetation to a combination of geological, physiographical and meteorological conditions. The practically horizontal stratification of the St. Louis limestone, which here is covered by loess, and the slight differences in level, afford but little drainage to the large amounts of precipitation during the earlier part of the year when the amount of evaporation is slight. When finally this moisture seeps away through the fissures in the limestone, it is permanently lost. In contrast to the almost swampy conditions of the spring, the soil, during summer and autumn, is dry, the evaporation being largely in excess of the precipitation and the underground drainage almost nil. Hence the spring brings a luxurious growth of grasses and is the only period when sufficient moisture is present for seeds to germinate. As a result there is a profuse spring flora composed of annuals, and a summer flora consisting of annuals the seeds of which germinated during the spring months, together with some of the perennials which are typical of the fall aspect of the prairie. Chief among the earlier plants are *Carex grisea, Agrostis alba* and *A. scabra, Danthonia spicata, Elymus striatus, Festuca tenella, Phleum pratense, Poa compressa* and *P. pratensis.* Here and there, in the bottom of slight valleys or in the vicinity of sinkholes, where the ground is swampy, one meets with *Carex laxiflora, C. lupulina,* and *C. riparia, Cyperus erythrorhizos, Elymus canadensis, Eragrostis reptans, Glyceria nervata* and *Panicum Crus-galli.* Where there is a slight elevation *Panicum depauperatum* is dominant. When, with the increase of evaporation, the prairies become dry, most of the species just enumerated disappear. Their places are taken by others, especially *Andropogon furcatus, A. scoparius* and *Eatonia obtusata.*

Grasses, though numerically the most important members of this prairie flora, are not by any means the most striking. During the late fall they are but little in evidence, their decaying stems forming a light-colored mat. Between the broken, prostrate stems of the fall-blooming Compositae are bright patches of green derived from the winter rosettes of several perennials. The typical winter rosette of *Lechea major* is striking. Patches of *Trifolium repens,* rosettes of *Capsella Bursa-pastoris,* of *Oenothera biennis* and its variety *muricata,* clumps of *Achillea Millefolium* and isolated dark green rosettes of *Arctium Lappa minus* and *Cnicus pumilus,* everywhere catch the eye, as do the rosettes of *Verbascum Thapsus, Verbena angustifolia, V. Aubletia, V. stricta* and *V. urticaefolia, Brunella vulgaris* and *Plantago Rugelii.* The brilliant yellow fruits of *Solanum carolinense* are found lying in all directions among the decaying herbs. Striking are large patches of *Croton capitatus* of which only the dried branches remain, still bearing the fruit. Here and there appear the bleached skeletons of *Datura Tatula,* while the browning stalks of evening primrose, pokeroot, mullein and numerous Compositae, give the whole a ragged appearance.

Most of the plants just mentioned do not attain their full development till late summer. While several, such as *Capsella Bursa-pastoris, Trifolium repens* and *Achillea Millefolium* produce flowers during the spring months, chiefly annual species are to be found in bloom at this time. The drier places are occupied by *Viola Rafinesquii, Plantago virginica* and *Antennaria plantaginifolia.* Where the ground is very moist one finds *Myosurus minimus.* Other species now appearing and flowering are *Lepidium virginicum, Sisymbrium canescens, Helianthemum canadense, Cerastium viscosum, Polygala verticillata* and *Androsace occidentalis.* Rosettes of fall-blooming species begin to develop, such as those of *Lactuca Scariola, L. Scariola integrata,* and *Verbascum Blattaria. Plantago patagonica aristata, P. pusilla* and *P. Rugelii* are frequent. *Rumex Acetosella* occurs everywhere as do rosettes of *Rumex obtusifolius. Allium cernuum* sometimes covers large patches. To these, the summer months add *Sisymbrium officinale, Hypericum maculatum,* several Leguminosae, especially *Cassia Chamaecrista, Lespedeza capitata, Psoralea tenuiflora* and *Stylosanthes elatior, Diodia teres, Apocynum androsaemifolium, Asclepias tuberosa* and *A. verticillata, Physalis angulata, Isanthus caeruleus* and *Sisyrinchium anceps. Abutilon Avicennae, Datura Tatula,* occasionally also the white-flowered *D. Stramonium* and the brilliant red shoots of *Phytolacca decandra* elevate themselves above the rest of the vegetation as do the flower stalks of *Oenothera biennis, O. biennis muricata, Verbascum Thapsus* and *V. Blattaria.* At this time too the Compositae have reached and in some cases passed their full rosette growth, though late summer and early autumn find them at their zenith. Species of *Helianthus, H. grosse-serratus, H. laetiflorus, H. mollis, Heliopsis laevis* and *H. scabra,* together with *Cnicus arvensis* (rare) and *C. pumilus, Erigeron canadensis, Lactuca Scariola, L. Scariola integrata* and *Silphium terebinthinaceum* are the first to flower. They are followed by the Asters, *A. novae-angliae, A. oblongifolius, A. patens* and *A. sagittifolius,* and these in their turn by the goldenrods of which *Solidago canadensis, S. nemoralis* and *S. petiolaris* are the most common, *S. serotina* being less common here and *S. speciosa* rare. *Aster sagittifolius* is the last to flower during November, at which time the prairies gradually assume their winter aspect.

Thickets.

Bordering the prairie and forming a transition between it and the deciduous oak forest, one finds an accumulation of shrubs of greater and lesser heights, causing the one to grade into the other. This thicket is fringed with low growing shrubs such as the early flowering *Rhus canadensis*, *Ribes gracile* and *Symphoricarpus vulgaris*, the brilliant red fruit of which forms a striking feature of the landscape during the winter months and to which the plant owes its name of coral berry. These are succeeded by taller shrubs, notably *Rhus glabra* and *Sambucus canadensis*, with which, in different localities, *Euonymus atropurpureus*, *Cercis canadensis*, *Rhamnus lanceolata*, *Pyrus coronaria* and *Cornus asperifolia* are associated in greater or smaller numbers, one of the species usually being subdominant. On the plateau at Jefferson Barracks, south of the buildings, *Prunus Persica* in places forms extensive thickets. The undergrowth is composed of various shrubby Rosaceae, notably *Rosa arkansana* and *R. blanda*, *R. humilis* being less frequent, *Rubus canadensis*, together with *Rubus occidentalis* and *R. villosus*. Grape vines, *Vitis riparia*, as well as *Celastrus scandens*, *Menispermum canadense* and *Smilax ecirrhata*, *S. herbacea* and *S. hispida* twine through the bushes as does, in the latter part of the year, *Polygonum dumetorum scandens*. *Rhus Toxicodendron* in places is abundant. This happens especially where the outer fringe of the thicket is composed almost exclusively of *Rubus canadensis*, which in late summer and fall is sometimes completely hidden by the poison oak. The forest trees which border the prairie are chiefly *Quercus alba*, *Q. coccinea tinctoria* and *Q. Muhlenbergii*, an occasional large specimen of *Platanus occidentalis* being found. *Quercus stellata* is frequent here.

Between the outer fringe of *Symphoricarpus vulgaris* and the prairie proper lies a narrow zone, encroaching upon both, and occupied by herbaceous plants. In the earlier portion of the year *Claytonia virginica*, *Viola palmata* and *V. palmata* *cucullata, Geranium maculatum, Oxalis stricta* and *Phlox divaricata* occur. Later some of these disappear and give place to *Geum album, Potentilla canadensis, Heuchera americana, Oxalis cymosa, Erigeron annuus, Polemonium reptans, Cynoglossum virginicum, Hedeoma pulegioides, Scutellaria canescens* and *S. versicolor*. In the fall *Galium Aparine, G. concinnum, Eupatorium ageratoides,* and *Vernonia noveboracensis* take their places, as do *Monarda fistulosa* and *Pycnanthemum linifolium,* the rosettes of which have been in evidence during the greater part of the year. Where the thicket is more or less open, one finds, during the spring months, *Delphinium tricorne, Thalictrum purpurascens, Podophyllum peltatum, Cypripedium pubescens, Arisaema Dracontium,* and *A. triphyllum.*

THE MISSOURI BLUFF.

The cliff.

This, on the Missouri side, is limited to the upper portion of the bluff, the walls of which are almost perpendicular and sometimes even concave. Here and there ledges occur on which soil accumulates as it does in the numerous crevices of the limestone. Occasionally larger blocks of the latter have become separated from the main body, and, being thus more exposed to the action of the elements, show the full extent of the disintegration caused partly by the weather, partly by the dissolving influence of the water and partly by plant action (plate 12, 2). The shallowness of the soil and the exposed position, resulting in an almost total loss of the water of precipitation by drainage and evaporation, bring with it a rather luxuriant spring flora composed chiefly of rosette-forming annuals, and a fall flora of rosette-forming biennials and perennials. The principal vernal plants are *Arabis canadensis, Capsella Bursa-pastoris, Draba cuneifolia, Erysimum asperum, Lechea major, Silene antirrhina, Astragalus mexicanus, Polygala verticillata, Heuchera hispida, Androsace occidentalis, Phlox pilosa, Lithospermum canescens, Monarda Bradburiana* and *Scutellaria parvula.* The principal spring grasses are *Melica diffusa* and *Panicum depauperatum.* Numerous perennials enlarge their rosettes at this time, notably *Eryngium yuccaefolium, Verbascum Thapsus* and *Agave virginica* as well as several Compositae. *Gymnostomum curvirostre* is the moss chiefly encountered. It may be found here during the entire summer. Lichens cover the surface of the rocks, principally *Parmelia capitata, Physcia stellaris* and *Peltigera rufescens.*

During the summer this flora is augmented by *Polanisia graveolens,* derived from the plants on the railroad tracks at the foot of the bluff, *Hypericum maculatum, Linum virginicum, Pimpinella integerrima, Sporobolus asper* and *S. vaginaeflorus.* In the fall Compositae are most prominent, especially *Aster oblongifolius* and *A. novae-angliae, Coreopsis palmata, Solidago Drummondii* and *S. ulmifolia.* A fern, *Pellaea atropurpurea,* is to be found here throughout the year, taking advantage of the slightest amount of soil in crevices; *Cheilanthes lanuginosa* and *Woodsia obtusa* are met with from spring till autumn. Trees and shrubs have found lodgment here and there, but are neither frequent nor abundant. They include, beside the local species of *Rhus, Amelanchier canadensis* and *Fraxinus viridis.* The principal creeper is *Tecoma radicans.*

At the top of the bluff there frequently occurs a narrow strip, but a yard or so wide, which appears to be occupied mainly by *Panicum depauperatum,* Leguminosae and Compositae, while in spring *Capsella Bursa-pastoris* and *Androsace occidentalis* are quite common. While the Compositae are those of the cliff proper, with the addition of *Rudbeckia hirta,* the Leguminosae form a feature not possessed by the cliff. They consist mainly of *Desmodium marilandicum, D. paniculatum, Psoralea tenuiflora* and *Stylosanthes elatior.* Here also occur large patches of *Cladonia fimbriata.* This, during the winter months, is practically the only species encountered here, just as the cliff flora is limited to the rosettes of *Lechea major* and *Verbascum Thapsus,* together with *Pellaea atropurpurea.*

Talus.

With the exception perhaps of the flora surrounding the lakes near the Illinois bluffs, there is no station in the entire section studied which presents so great an assortment of species and genera, so luxuriant a plant growth, as does the talus of the Missouri bluffs. The flora combines many of the elements of the plateau forest, and of the ravine in addition to those of the cliff, while at the same time the railroad, which passes at the foot of the bluff, is instrumental in the introduction and distribution of not a few species. The numerous springs and the drainage from the plateau offer a never-failing source of moisture, the amount of which never, except perhaps in the early part of the year, becomes excessive, owing to the slope. The soil is of the richest since in addition to the humus locally formed, a large amount of colluvial soil is annually obtained from the plateau. The exposure being an eastern one, the plants have the benefit of the early morning sun and are protected from the too ardent afternoon rays. All these factors combine to bring about optimum conditions and are largely instrumental in enabling the talus to support a vegetation without parallel in this region.

Trees and shrubs are numerous. The most prominent are *Asimina triloba, Ceanothus americanus, Rhamnus caroliniana, Aesculus glabra, Negundo aceroides, Cercis canadensis, Fraxinus americana,* several species of *Quercus* and *Populus monilifera. Ilex decidua* occurs at Wickes only. The undergrowth is composed largely of *Celastrus scandens, Rhus Toxicodendron, Rosa setigera, Rubus occidentalis* and *R. villosus.*

While the foregoing species give the general aspect and clothe the lower hill with verdure, the herbaceous plants furnish the brighter colors, especially during the late summer and fall, when yellow is the dominant color. The spring brings with it various Ranunculaceae, such as *Anemone virginiana, Ranunculus abortivus* and *R. septentrionalis,* as well as other low growing species. These include *Podophyllum peltatum, Sanguinaria canadensis, Viola palmata, V. palmata cucullata, V. Rafinesquii, Claytonia virginica, Geranium carolinianum* and *G. maculatum, Trifolium pratense, T. repens, Fragaria virginiana, Potentilla canadensis, Chaerophyllum procumbens, Phlox divaricata, P. pilosa, Hydrophyllum appendiculatum, H. canadense,* and *H. virginicum, Lithospermum canescens,* with its striking, orange-colored flowers, *L. latifolium, Brunella vulgaris, Trillium recurvatum* and *T. sessile, Polygonatum giganteum, Smilacina racemosa, Arisaema Dracontium* and *A. triphyllum,* as well as numerous mosses, liverworts and lichens, which, together with *Nepeta Glechoma,* run over the ground and rocks. On the whole, the spring flora is a rosette formation, differing only numerically, both as to species and individuals, from the flora of the cliff. As soon as the too abundant water has disappeared, partly owing to a diminution of the drainage from the plateau, partly because of an increase in evaporation, a most luxuriant summer flora makes its appearance, in which Leguminosae, Umbelliferae, Compositae and Labiatae are best represented. *Astragalus canadensis,* of which the rosettes bore flowers in April, is seconded by *A. mexicanus. Cassia Chamaecrista, Desmanthus brachylobus, Strophostyles angulosa* and *Schrankia uncinata* appear. *Discopleura Nuttallii, Eryngium yuccaefolium* and *Osmorrhiza brevistylis* make their appearance as isolated individuals. *Sanicula marylandica* is everywhere. Different Compositae, mainly *Helianthus grosse-serratus* and *H. hirsutus,* as well as *Rudbeckia laciniata,* have begun to produce their first flowers, while here and there clumps of *Monarda fistulosa, Pycnanthemum linifolium* and *Scutellaria canescens* add patches of bright green. *Galium Aparine* and *G. concinnum* appear at the edges, as does *Tradescantia virginica,* together with grasses, chiefly *Muhlenbergia glomerata* and *Uniola latifolia. Polygonatum giganteum* has now reached its highest development and occurs in specimens which truly make the plant deserve its specific name. In the late summer and fall, besides *Impatiens fulva, Cassia marylandica* and *Campanula americana,* Compositae such as *Eupatorium ageratoides, E. coelestinum, Rudbeckia laciniata, Silphium integrifolium, Solidago latifolia* and *Vernonia noveboracensis,* occur frequently. The winter aspect of the talus is derived chiefly from the shrubs and trees.

THE RAILROAD RIGHT OF WAY.

Ditches.

These, bare during the winter, except for the rosettes of *Capsella Bursa-pastoris* and *Taraxacum officinale,* and cleared at various times during the year, harbor none but species with perennial roots or those the seeds of which are produced in great abundance. The spring flora, in addition to the two species just mentioned, is limited chiefly to the Carices, and it is the summer which brings a comparatively large number of species, many of them water-loving. Among them *Lactuca Scariola, L. Scariola integrata, Lippia lanceolata, Stachys palustris, Oxybaphus nyctagineus,* and species of *Polygonum,* are prominent. Where there is standing water one sometimes meets with *Typha latifolia* and *Lemna perpusilla.* This summer aspect is not materially changed during the autumn.

The embankment.

The railroad tracks themselves do not present conditions favorable to plant growth and this is limited to occasional rosettes of *Capsella Bursa-pastoris, Lepidium virginicum, Portulaca oleracea, Taraxacum officinale, Amaranthus retroflexus* and *Mollugo verticillata,* both the *Amaranthus* and the *Portulaca* not appearing till the year is well advanced, while the rosettes of *Mollugo verticillata* remain till the October frosts kill them.

The land on either side of the track harbors a large number of species. The stretch next to the hillside is occupied mainly by many of the herbaceous plants which properly belong there while the opposite side bears numerous grasses or a growth of *Rhus glabra,* which from time to time, and especially during the late summer, is cleared away, being cut and subsequently burned over (plate 16). Among the principal grasses, besides *Poa pratensis,* are *Asprella Hystrix, Bromus secalinus, Dactylis glomerata* and *Phleum pratense,* to which, during the summer, *Eleusine indica, Panicum sanguinale,P halaris canariensis, Setaria glauca, S. italica, S. viridis* and *Triodia cuprea* are added. *Hypericum perforatum, Oenothera biennis, Matricaria discoidea* and *Verbascum Thapsus,* as well as *Commelina communis* and *C. virginica* are typical here, as are the different species of *Plantago. Abutilon Avicennae, Rhus Toxicodendron, Achillea Millefolium, Lactuca leucophaea integrifolia,L. Scariola* and *L. Scariola integrata, Datura Tatula* and *Tecoma radicans* never fail. *Daucus Carota* which, coming from the west, has increased to a remarkable extent during the last five years, sometimes covers extensive tracts. *Polanisia graveolens,* introduced with the railroad ballast obtained from the Meramec River gravelbars, is met with. Compositae are always a most striking feature. They are chiefly *Helianthus annuus, Rudbeckia hirta, Silphium integrifolium, Solidago canadensis* and *S. serotina.*

Cuts.

Here and there, where cuts have been made in grading the railroad, banks, some six feet in height, separate the tracks from the bottom lands. These banks support a flora largely composed of low growing herbs, or at least of those plants which form spring rosettes, the conditions being strictly xerophytic. Striking is, during the spring months, *Corydalis aurea.* Here and there brambles have taken possession. The Ranunculaceae are conspicuous by their absence. Grasses, chiefly *Poa pratensis* and *P. compressa, Bromus secalinus* and *Elymus canadensis,* together with *Fragaria virginiana* and *Potentilla canadensis,* form the spring flora. *Sisyrinchium albidum* and *S. anceps,* as well as *Hypoxis erecta,* are not infrequent. During the summer Leguminosae dominate. *Melilotus alba,* throwing up tall shoots from its biennial root, is the most striking, especially during the late summer, while the yellow-flowered *M. officinalis,* less tall but more graceful, is not infrequent during the earlier part of the year. Several species of *Desmodium* and *Trifolium* are frequent. *Solanum rostratum* and the more abundant and more frequent *Solanum carolinense* occur, as well as patches of *Antennaria plantaginifolia* and clumps of *Achillea Millefolium.* During the fall Compositae of lesser stature are dominant, notably *Aster ericoides* and *A. multiflorus, Coreopsis tripteris, Erigeron canadensis, Silphium integrifolium* and *Solidago canadensis.*

Ponds.

Here and there along the railroad occur shallow ponds, filled with stagnant water and largely drying out during the later part of the year. On their borders they support a vegetation composed mainly of Umbelliferae and Polygonaceae together with rushes and grasses. *Cicuta maculata* and *Sium cicutaefolium* are most frequent, as are *Polygonum Hydropiper, P. hydropiperoides, P. Muhlenbergii* and *P. Persicaria.* Several species of *Carex, Cyperus acuminatus, C. erythrorhizos, Dulichium spathaceum, Eleocharis acicularis, E. ovata, Eriophorum lineatum* and *Scirpus lacustris, Alopecurus geniculatus, Eragrostis reptans, Glyceria nervata, Leersia oryzoides, Panicum Crus-galli* and *Spartina cynosuroides* are frequent, as are patches of *Typha latifolia.* Different species of *Sagittaria* frequently occupy the major part of the ponds. Here and there *Alisma Plantago* occurs. While *Cephalanthus occidentalis,* either isolated or in groups, is ordinarily found at every pond, *Acer dasycarpum* and *Betula nigra* may likewise be encountered. Lythraceae-Onagraceae, such as *Ammania coccinea, Rotala ramosior,* and *Ludwigia palustris,* are not infrequent. *Jussieua repens,* though seldom absent, nowhere on the Missouri side attains the truly magnificent development exhibited in the American Bottoms. During the summer *Iva ciliata, Ilysanthes riparia, Mimulus ringens, Veronica peregrina, Lobelia syphilitica, Lycopus sinuatus* and *L. virginicus* are always found in the immediate vicinity of ponds. Later *Aster salicifolius, Coreopsis aristosa* and its variety *mutica* are added.

THE MISSOURI BOTTOM.

The dry bottom.

The dry bottom, on the Missouri side, comprises a strip some twenty to fifty yards wide immediately adjacent to the railroad tracks but situated several feet lower. Trees and shrubs are ordinarily isolated and consist of specimens of *Acer dasycarpum, Aesculus glabra, Gleditschia triacanthos, Gymnocladus canadensis, Robinia Pseudacacia, Amelanchier canadensis, Prunus serotina, Fraxinus americana, Ulmus fulva, Morus rubra* and *Betula nigra,* with here and there brambles and plants of *Vitis cinerea* and *V. riparia, Rhus Toxicodendron* and *Tecoma radicans.* The more common weeds occur with the greatest frequency, among them *Myosurus minimus,* *Ranunculus abortivus, Capsella Bursa-pastoris, Geranium carolinianum, Oxalis stricta, Melilotus alba, Trifolium repens, T. pratense, Chaerophyllum procumbens, Potentilla canadensis, Erigeron annuus* and *E. canadensis,* different species of *Lactuca, Apocynum cannabinum, Verbascum Thapsus, Plantago lanceolata, P. patagonica aristata* and *P. Rugelii,* together with *Cyperus ovularis, Eleocharis tenuis, Agrostis scabra, Elymus striatus* and *Poa pratensis.* The summer adds to these *Anemone pennsylvanica, Abutilon Avicennae,* several species of *Lespedeza* as well as other Leguminosae, *Galium triflorum, Actinomeris squarrosa, Artemisia biennis, Bidens bipinnata, Erigeron strigosus, Eupatorium purpureum* and *E. serotinum, Rudbeckia laciniata, Xanthium canadense, Steironema ciliatum* and *S. lanceolatum, Asclepias Cornuti, A. obtusifolius* and *A. purpurascens, Enslenia albida, Convolvulus Sepium* and *Ipomoea pandurata, Datura Tatula, Solanum nigrum, Pentstemon laevigatus Digitalis, Blephilia hirsuta, Amaranthus retroflexus, Phytolacca decandra, Chenopodium album, Polygonum dumetorum scandens* and *Euphorbia Preslii.* In the fall *Helenium autumnale* and *Atriplex patulum hastatum* are added. Mention should be made of clumps of *Clematis virginiana* occurring here and there throughout the year.

The wet bottom.

In contrast to the dry bottom, the wet bottom supports a flora of great luxuriance, though not particularly rich in species. Willows here form the main tree growth, chiefly *Salix cordata* × *sericea, S. longifolia* and *S. nigra,* together with *Populus monilifera,* while close to the river lower plants of these species, together with small trees of *Betula nigra,* are very much in evidence, forming, together with a number of herbaceous plants, a broad hedge. Back of this hedge and gradually passing into the dry bottom, lies a strip, varying in width, but measuring on an average fully four fifths of the entire bottom, which may well be called a park landscape in miniature. The willows constitute small woods, the trunks being clear and the trees relatively close together. Smaller willows and small trees of *Betula nigra* form clumps of shrubbery among which numerous vines, *Cissus Ampe-*

lopsis, *C. stans*, *Vitis cinerea*, *V. cordifolia*, *V. palmata* and *V. riparia*, together with *Tecoma radicans*, find their way. At times the wild grapes entirely cover their support. *Echinocystis lobata*, *Convolvulus Sepium* and *Polygonum dumetorum scandens*, twine among the bushes (plate 14, 2). *Myosurus minimus*, *Ranunculus abortivus*, *R. septentrionalis*, *R. repens*, *Capsella Bursa-pastoris*, *Nasturtium obtusum*, *Cerastium nutans*, *Stellaria longifolia*, *Hypericum mutilum*, *Oxalis stricta*, *Oenothera biennis*, *Chaerophyllum procumbens*, *Valerianella radiata*, *Senecio aureus*, *S. aureus Balsamitae*, *Taraxacum officinale*, *Brunella vulgaris*, *Euphorbia humistrata* and *Allium cernuum* form a mat, together with the sedges and grasses, mainly *Carex conjuncta*, *C. granularis*, *C. monile*, *Scirpus atrovirens*, *Alopecurus geniculatus*, *Elymus virginicus*, *Eragrostis reptans*, *Leersia virginica*, *Panicum Crus-galli*, and *Spartium cynosuroides*, covering the intervening ground with verdure. Here and there single plants of *Hibiscus lasiocarpus* stand out prominently as well rounded clumps. A similar appearance is presented by plants of *Iris versicolor*. Different species of *Polygonum*, among which *P. Hartwrightii* is the most striking (plate 17) take possession of large tracts, especially where the ground is somewhat higher. Other species prominent during the summer and autumn are *Baptisia leucantha*, *Lespedeza capitata*, *Bidens cernua*, *Coreopsis aristosa*, *C. aristosa mutica*, *Eupatorium purpureum*, *E. serotinum*, *Helenium nudiflorum*, *Iva ciliata*, *Silphium perfoliatum*, *Vernonia fasciculata* and *V. noveboracensis*, *Asclepias incarnata*, *Blephilia hirsuta*, *Lophanthus nepetoides*, *Chenopodium ambrosioides* and *C. ambrosioides anthelminticum*, different species of *Rumex* and *Saururus cernuus*. In fall the Compositae, especially *Aster diffusus* and *A. salicifolius*, are most prominent. Among the plants whose presence is not so readily recognized must be mentioned numerous species of *Cuscuta*.

There exists a marked difference between the Missouri bottoms of the Mississippi and the bottoms of the River des Pères, near the spot where it enters the larger river. The bottoms of the River des Pères at this point show several terraces, the lower one of which is illustrated (plates 18, 19).

While the bottoms on the north side are covered chiefly by grasses, trees and shrubs form the most striking feature of the bottoms on the south side. The lower terrace is occupied in part by willows, *Salix cordata* × *sericea, S. longifolia, S. nigra* and *S. sericea,* and by *Forestiera acuminata.* Among the larger herbs *Vernonia noveboracensis* is most prominent. *Chaerophyllum procumbens* and *Senecio aureus* are striking features of the spring flora. This lower terrace has partly been invaded by the more common roadside weeds, such as *Arctium Lappa minus.* Species of *Verbena* are common. There are a few trees of *Ulmus americana* and *Gleditschia triacanthos. Forestiera acuminata* forms large clumps. The higher terraces are occupied by *Ulmus fulva* and oaks, chiefly *Quercus bicolor, Q. macrocarpa* and *Q. palustris,* by walnuts, *Juglans cinerea* and *J. nigra,* and by hickories, mainly *Carya amara.* Here occur two specimens of *C. olivaeformis,* the only representatives in our section on the Missouri side. Several species of *Crataegus* are found here.

In connection with the wet bottoms must be mentioned the great similarity of the flora of these regions to that of the swamps on the plateau, where the most striking features are willows and *Iris versicolor* (plate 14).

THE RIVER.*

The Missouri Shore.

On the Missouri side of the Mississippi, the river shore may be divided into three zones, which, in the earlier part of the year, ordinarily are submerged, appearing in summer and autumn only. The first zone, immediately adjoining the water, is from two to four yards wide and is composed of the St. Louis limestone, not covered by mud. Probably the constant change of level of the river, varying within a few feet, is sufficient to prevent the accumulation of any deposit. There is no vegetation unless of a transient nature and limited to algae left behind by the waters of the river in the small shallow pools, seldom more than one foot in diameter. In the second zone, with a width of from five to ten yards, the stones are covered by a thicker or thinner layer (0–12 in.) of mud, which apparently supports no vegetation. There is a slight accumulation of driftwood. This is followed by the third and broader zone. Its lowest limit is the summer and fall level of the river. The width varies from twenty to forty yards. The lower portion is characterized by a strip, one foot wide and more or less undulating, occupied by *Cyperus acuminatus, C. diandrus* and *Fimbristylis autumnalis.* Separated from this by a strip of bare mud, about a foot in width, lies a strip about 12 inches wide, covered by dwarf plants of *Coreopsis aristosa mutica.* A third strip, again placed at about one foot distance and as broad, contains nothing but seedlings of *Salix longifolia,* from two to three feet high, interspersed with seedlings of *Betula nigra* and *Populus monilifera.* Here occasionally a rosette of *Capsella Bursa-pastoris* is seen. Numerous are small fronds of *Riccia natans.* The second part of this third zone, from fifteen to thirty-five yards wide, contains rosettes of *Capsella Bursa-pastoris* only, the rosettes being placed at some distance from each other. The upper portion of the third zone, situated considerably higher than the rest, shows small plants of *Nasturtium obtusum, N. palustre, Geranium carolinianum, Artemisia ludoviciana, Vernonia fasciculata, Samolus Valerandi americanus, Ipomoea purpurea, Solanum nigrum, Conobaea multifida, Lippia lanceolata, Acnida tuberculata, Rumex crispus* and *R. maritimus, Polygonum aviculare, P. hydropiperoides* and *P. Persicaria,* as well as the plants of the middle zone. Here too are rosettes of *Lactuca canadensis* and *L. Scariola integrata* as well as rosettes of *Daucus Carota.* In autumn rosettes of *Juncus tenuis,* at first sight readily mistaken for *Isoetes,* are numerous. In this zone belong the algae found in the small creeks, where *Cladophora glomerata* is most numerous, forming a green felt over the rocks. This species extends into the middle of the third zone.

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* The plankton of the Mississippi has been omitted from this study.

As is but natural, the river shore proper is of an exceedingly variable nature. Not everywhere may the zones just described be found so clearly defined. In places the upper zone is but narrow, the current of the river having been deflected by an obstruction at some distance. As a result river deposit has accumulated between the stems of the *Salix*, *Betula* and *Populus* seedlings, forming a miniature levee, through the action of which the land lying behind has been elevated and drained, thus forming a wet bottom. In other places the river, during the spring, has taken complete possession of both wet and dry bottom, and in consequence, during summer and fall, the upper zone of the river shore extends to the natural or artificial levee. Where this is the case there ordinarily remains some shrubbery along the base of the levee. Prominent here is usually *Equisetum robustum*. *Eragrostis reptans* covers the banks and its dried stems and leaves are the most striking winter feature.

Islands.

In the fall of the year, with the lowering of the river level, the sandbars are enabled to support a vegetation which does not differ materially from that of the river shore. Conditions here are very much as depicted by Cowles* for the Illinois River. Young specimens of *Salix longifolia*, *Betula nigra* and *Populus monilifera*, together with *Juncus nodosus megacephalus* and *J. tenuis*, *Cyperus diandrus* and *C. strigosus*, are the plants principally found here. *Nasturtium obtusum* and *N. palustre* as well as *Ambrosia trifida* and *Chenopodium ambrosioides anthelminticum* are among the first to make their appearance. Where the island rises so as to offer a permanent foothold (plate 11), *Salix longifolia* is dominant, forming a dense thicket. Associated with it are *S. cordata* × *sericea* and *S. nigra*, *Betula nigra*, *Populus monilifera*, *Prunus serotina*, *Sambucus canadensis* and several herbaceous species which include, besides those just mentioned, *Desmodium Dillenii* and *D. paniculatum*, *Datura Stramonium* and *D. Tatula*, *Solanum nigrum*, *Cyperus aristatus*, *C. Schweinitzii* and *C. speciosus*. Plants of *Riccia natans* are numerous.

Mudflats.

The shifting accretions of silt, chiefly on the Illinois side, support, at low water, a vegetation similar to that of the shore and river islands. *Salix longifolia* and *Populus monilifera* are represented by numerous seedlings. There is, of course, no spring flora. Plants ordinarily occur as isolated individuals. There appears to be a greater number of species here than on the islands. Among the plants encountered are *Capsella Bursa-pastoris, Cardiospermum Halicacabum, Rotala ramosior, Jussieua repens, Ambrosia trifida, Bidens cernua, B. chrysanthemoides, B. connata, Erigeron annuus, E. canadensis, E. strigosus, Eupatorium purpureum, E. serotinum, Helenium autumnale, Iva ciliata, Pluchea camphorata, Datura Stramonium, D. Tatula, Solanum carolinense, S. nigrum, Gratiola sphaerocarpa, G. virginiana, Mimulus alatus, Veronica peregrina, Lippia lanceolata, Acnida tuberculata, Euphorbia humistrata, E. Preslii, Polygonum Hydropiper, P. hydropiperoides, Cyperus aristatus, C. diandrus, Diplachne fascicularis, Eragrostis reptans* and *Paspalum fluitans.* This flora disappears with the advent of the high water and all seed is washed away. Since the position of the mudflats is continually changing, it is clear that for a fresh supply of seed an external source must be relied on. While several of the plants bear seeds which are fitted for transportation by wind, it is probable that the seed of many of these species as well as of others is derived from the debris brought down each spring in large quantities.

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* Cowles, H. C. The Physiographic Ecology of Chicago and Vicinity; a Study of the Origin, Development and Classification of Plant Societies. Bot. Gaz. **31** : 73. 1901.

The Illinois shore.

The sandy shore on this side supports but a scant vegetation. *Salix longifolia* and *Populus monilifera* are never absent. Different herbaceous plants are added during the year. Characteristic are *Oenothera biennis, Xanthium canadense* and *Plantago patagonica aristata. Polygonum aviculare* and *P. erectum* make their appearance as do *Cyperus acuminatus, C. aristatus, C. diandrus, C. Schweinitzii, C. speciosus* and *C. strigosus.* Less important though still fairly numerous are *Nasturtium obtusum, N. palustre, Linum usitatissimum, Geranium carolinianum, Desmodium cuspidatum, D. Dillenii* and *D. paniculatum, Trifolium hybridum* and *Verbascum Thapsus.* Compositae are prominent in the latter part of the year. The most important are *Artemisia ludoviciana, Bidens connata, Coreopsis aristosa* and *C. aristosa mutica,* *Eupatorium purpureum* and *E. serotinum.* There occur occasional specimens of *Datura Stramonium* and *D. Tatula, Solanum carolinense* and *S. nigrum.* In places *Chenopodium ambrosioides* and *C. ambrosioides anthelminticum* take complete possession. *Equisetum laevigatum* is not frequent. *Aristida oligantha* and *Sporobolus vaginaeflorus* appear in the latter part of the year.

THE ILLINOIS BOTTOM.

The dry bottom.

That portion of the Illinois bottom usually designated as dry" bottom and possessing a sandy soil, supports a rich and greatly diversified flora, in sharp contrast with the drier and higher portions of the Mississippi bottom in St. Louis county, where the soil is a heavy clay.

The spring flora is rich in Ranunculaceae, such as *Anemone pennsylvanica, Myosurus minimus, Ranunculus abortivus, R. repens, R. septentrionalis,* and in Cruciferae. *Capsella Bursa-pastoris, Dentaria laciniata, Draba brachycarpa* and *D. caroliniana, Nasturtium sinuatum, Sisymbrium canescens* and *S. officinale, Cerastium arvense, C. arvense oblongifolius,* and *C. nutans* are everywhere, as are rosettes of *Geranium carolinianum* and *Oxalis stricta.* Among the Umbelliferae *Chaerophyllum procumbens* and *Cryptotaenia canadensis* are most frequent at this time. *Sonchus asper* and *S. oleraceus* are everywhere, as are *Verbena stricta* and *V. urticaefolia, Brunella vulgaris* and the local species of *Plantago.* Carices and other Cyperaceae are numerous. The summer adds several Cruciferae as well as Leguminosae, such as *Cassia Chamaecrista, Crotalaria sagittalis, Desmodium canescens, D. ciliare, D. cuspidatum, D. Dillenii, D. paniculatum* and *D. rigidum, Glycyrrhiza lepidota, Lespedeza capitata, L. procumbens, L. violacea, Melilotus alba, M. officinalis, Strophostyles angulosa, S. pauciflora, Trifolium hybridum, T. pratense* and *T. repens,* together with a large number of Compositae. These include *Ambrosia artemisiaefolia, A. bidentata* and *A. trifida, Aster patens, Bidens bipinnata, Erigeron canadensis, E. philadelphicus* and *E. strigosus, Helianthus annuus, H. tuberosus, Solidago canadensis, S. serotina* and several others. The Compositae are predominant during the autumn. Where there are woodlands, *Quercus coccinea tinctoria, Q. imbricaria, Q. macrocarpa* and *Q. Muhlenbergii*, together with *Acer dasycarpum* and *Ulmus fulva*, are the species principally encountered.

The wet bottom.

This can be compared directly with the similar region on the Missouri side of the Mississippi, though it is much broader, and, like the dry bottom just mentioned, has been converted almost entirely to agricultural purposes. Here and there remain patches sufficiently large to give an idea of the original flora. This original flora consisted largely of trees and shrubs, the formation being frequently interrupted by sloughs, lakes and swamps. There seem to have been two principal zones. The one, bordering the river and forming a strip of variable width, ordinarily averaging one-half mile, was, and still is, covered by a growth of willows among which *Salix longifolia* is predominant (plates 11, 16). The remainder of the wet bottom appears to have been covered with woods. These, for the greater part, have yielded to the axe. Portions of these woods still remaining will be taken up under a separate heading.

To a rich spring flora, among which Ranunculaceae such as *Isopyrum biternatum, Myosurus minimus, Ranunculus abortivus* and *R. oblongifolius* are the most frequent, with the exception of some Cruciferae, succeeds a luxuriant summer flora, largely consisting of *Hypericum mutilum* and *H. perforatum, Abutilon Avicennae, Oxalis stricta, Amorpha fruticosa, Cassia Chamaecrista,* specimens of *Baptisia leucantha* in groups of two or three, *Potentilla norvegica* and *P. rivalis millegrana,* numerous Compositae, *Asclepias incarnata, Convolvulus Sepium, Ipomoea hederacea, I. lacunosa, I. pandurata* and *I. purpurea, Stachys palustris, Datura Stramonium* and *D. Tatula, Phytolacca decandra, Polygonum acre, P. hydropiperoides, P. lapathifolium* and *P. Persicaria, Rumex maritimus* and *R. crispus, Euphorbia glyptosperma, E. humistrata* and *Boehmeria cylindrica.* A large number of these persist till autumn, the additions at this time being mainly limited to the Compositae. Here and there occur clumps of willows, consisting of *Salix amygdaloides*, *S. amygdaloides* × *nigra*, *S. cordata*, *S. longifolia* and *S. nigra*, especially in the lower portions which frequently are submerged. Two points are to be noted, the one that species of *Crataegus* occur as isolated individuals which in some cases are the only representatives of the species,* and the other that the Mississippi River appears to act as a barrier to their distribution as pointed out by Sargent,† many of the species not being found in Missouri. This same point is illustrated by *Gleditschia aquatica*, specimens of which are not infrequent in the American Bottom opposite St. Louis, but which is not found in St. Louis county, though it appears on the Missouri side opposite Alton, which coincides with the change in physiography, since here the Illinois bluffs overhang the river while on the Missouri side there are vast bottom lands.

The wooded bottom.

The wooded bottom is mainly covered by *Carya amara* and *C. olivaeformis*, *Quercus bicolor*, *Q. macrocarpa*, *Q. palustris*, *Gleditschia triacanthos*, *Gymnocladus canadensis*, *Populus monilifera*, *Celtis mississippiensis* and *Celtis occidentalis*, though *Betula nigra* and *Ulmus americana* are not infrequent. The trees are placed close together, and except at the edges, few other species occur. Grapevines are most numerous, including *Ampelopsis quinquefolia*, *Vitis cinerea*, *V. cordifolia*, and *V. riparia*. The spring flora is limited to *Ranunculus abortivus*, *Capsella Bursa-pastoris*, *Claytonia virginica*, *Arisaema Dracontium* and *A. triphyllum*, *Sagittaria variabilis*, *Alisma Plantago*, *Carex granularis* and *C. laxiflora*. During the early part of the year rosettes of *Lactuca ludoviciana*, *Lobelia cardinalis* and *L. syphilitica* develop. *Lobelia cardinalis* is the most striking plant in the fall of the year, producing immense spikes 6–8 feet in height, bearing brilliant red flowers. At this time *Cassia marylandica* is conspicuous. There is an undergrowth of brambles.

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* Sargent, C. S. Manual of the Trees of North America. 1905.

† Sargent, C. S. Crataegus in Missouri. Rept. Mo. Bot. Gard. **19** : 35. 1908.

Sloughs.

The sloughs harbor a number of water-loving plants and are always bordered by herbs accompanied by a few trees and shrubs, of which the principal are *Gleditschia aquatica, Gymnocladus canadensis, Cephalanthus occidentalis* and *Betula nigra,* with here and there a clump of willows. *Sium cicutaefolium* occupies a place in the water near the bank, slightly in advance of the row of *Typha latifolia* which in many places fringes the banks. Where the water is shallow *Sagittaria variabilis, S. variabilis latifolia* and *Alisma Plantago* find a foothold. *Cardamine rhomboidea* and *Saururus cernuus* are frequent. On the wet banks grow *Nasturtium officinale* and *N. palustre, Penthorum sedoides, Rotala ramosior* and *Ilysanthes riparia,* with *Lippia lanceolata,* several species of *Polygonum* and *Equisetum robustum. Jussieua repens* runs out over the water and in places forms an apparent but continuous bank fully 6 feet wide.

Swamps.

Swampy grounds are abundant in the American Bottom, resulting from the partial drainage of some of its numerous lakes. They are ordinarily covered with a growth of willows, chiefly *Salix amygdaloides, S. amygdaloides* × *nigra, S. longifolia* and *S. nigra,* together with *Acer dasycarpum, Quercus bicolor* and *Q. palustris.* The flora is in places shrubby and then composed of *Ilex decidua, Gleditschia aquatica, Cephalanthus occidentalis* and *Betula nigra.* Herbaceous plants, most of them water-loving, are abundant. The species most frequently encountered in spring are *Ranunculus abortivus, Nasturtium palustre, N. sessiliflorum, Ludwigia palustris, Sium cicutaefolium, Senecio lobatus, Mentha canadensis, Scutellaria lateriflora, Iris versicolor, Acorus Calamus* and sedges. The summer adds to these *Hibiscus lasiocarpus, Aster salicifolius, Bidens Beckii, Solidago lanceolata, Lobelia syphilitica, L. cardinalis, Heliotropium indicum, Lycopus sinuatus* and *L. virginicus, Polygonum Hydropiper, P. hydropiperoides,* and *P. Muhlenbergii.* At this time *Isoetes mela-*

nopoda may sometimes be found. Other, rarer, species were found here by Dr. Engelmann. The fall aspect does not differ greatly from the summer aspect. Ranunculaceae and Cruciferae disappear as do the various sedges. On the other hand *Aster salicifolius* and *Lobelia cardinalis* at this time reach their greatest development.

Lakes.

So ample an account has been given of the lakes of the American Bottom by Coulter* that it is unnecessary to describe them here. It will suffice to point out some of the differences existing between the typical lowland lakes and those close to the bluff. The former are for the greater part open, while most of the latter are surrounded by a dense growth of trees, largely composed of *Tilia americana, Acer dasycarpum, Aesculus glabra, Gleditschia triacanthos, Morus rubra, Ulmus americana, Ulmus fulva, Betula nigra, Quercus bicolor, Q. macrocarpa, Q. Muhlenbergii* and *Q. rubra, Populus monilifera* and species of *Salix*. In places there is a dense undergrowth of *Euonymus atropurpureus, Sambucus canadensis* and *Cephalanthus occidentalis*, accompanied by *Vitis cinerea* and *V. cordifolia, Rosa setigera* and *Rubus villosus*. Here and there are open places where besides the *Hibiscus lasiocarpus* of the lowland lakes, *H. militaris* also occurs, forming isolated clumps. Among the herbs found near the bluff lake are *Agrimonia Eupatoria* and *A. parviflora*. *Lobelia cardinalis* properly belongs here, as do *Aristolochia tomentosa* and *Asarum canadense*, both from the lower hillside. Species of *Potamogeton* appear to be more frequent in the lowland lakes, but the bluff lakes harbor more specimens of *Eleocharis*. *Nuphar advena minus*, not found in the lowland lakes, where *Nymphaea odorata* occurs, is found in the bluff lakes. Here *Nelumbium luteum*, though sometimes found, is not so marked a feature (plate 20).

THE RAILROAD.

The main difference between the railroad right of way in Illinois and that in the Missouri portion of the section studied lies in the fact that while the latter is situated close to the bluff and in a comparatively dry situation, the former passes through the lowland at a distance from the hills. Besides, the railroads tap entirely different sections of the country and consequently one finds differences in the species of introduced plants, to be considered under a special heading.

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* *loc. cit.*

The main roadside aspect is given by grasses, chiefly *Poa pratensis*, with which *Agropyrum repens*, *Agrostis alba* and several other grasses are associated. The spring brings with it such species as *Myosurus minimus*, *Corydalis aurea*, *Capsella Bursa-pastoris*, *Lepidium intermedium*, *Nasturtium obtusum*, *Sisymbrium altissimum*, *S. canescens*, *S. officinale*, *Tribulus grandiflorus*, various clovers, *Mollugo verticillata*, *Plantago lanceolata*, *P. patagonica aristata*, *P. Rugelii* and *P. virginica*. Rosettes of *Oenothera biennis*, *Stellaria media*, *Lactuca Scariola*, *L. Scariola integrata* and *Verbascum Thapsus* are encountered from time to time. The occurrence of *Lilium canadense* is to be noted. The summer adds *Portulaca oleracea*, *Bergia texana* (rare), several Leguminosae, such as *Cassia Chamaecrista*, *Dalea alopecuroides*, *Desmodium canescens*, *Medicago sativa*, *Melilotus alba* and *M. officinalis*, as well as a number of Compositae, mainly *Ambrosia psilostachya*, *A. trifida*, *Helianthus annuus* and *H. grosse-serratus*, which in some places takes entire possession, *Solanum carolinense*, *Amaranthus albus*, *A. blitoides* and *A. retroflexus*, *Croton capitatus*, *Euphorbia humistrata*, *Setaria glauca*, *S. italica* and *S. viridis*, with here and there specimens of *Zea Mays*. The autumn sees some additions, mainly from the Compositae, and at this time too patches of *Linaria vulgaris* attract attention, as does the Russian thistle, *Salsola Kali Tragus*.

In the American Bottom there is ordinarily no bank enclosing the railroad as there is along the Missouri bluffs, fences separating it from the adjacent cultivated fields. Along these fences hedges frequently are formed, composed of brambles, together with *Cassia Chamaecrista*, *Tecoma radicans*, and *Rhus Toxicodendron*, among which *Ulmus americana* is not infrequent. The railroad ponds do not offer features distinct from those on the Missouri side, except for the occurrence of *Nelumbium luteum*, *Utricularia biflora* and *Echinodorus radicans*.

While the embankment is ordinarily kept free from plant growth and the conditions themselves do not favor vegetation, rosettes and isolated individuals of species occurring along the railroad right of way are found from time to time growing in the ballast.

THE ILLINOIS BLUFF.

Talus.

The talus at the foot of the Illinois bluffs presents the same general aspect as does that on the Missouri side of the section studied. It differs, however, in details, and for various reasons. Though both are at the base of limestone bluffs, the exposure is diametrically opposite. Though one would expect to find as a result that the flora on the Missouri talus was richer in species, the opposite is the case. Plants distributed by railroads are less important on the Illinois talus since this is partially skirted by a local line only.

The principal plants occurring on the Illinois talus but lacking in the corresponding locality in Missouri are *Stylophorum diphyllum, Arabis confinis, Viola striata, Hypericum Ascyron, Epilobium coloratum, Osmorrhiza longistylis, Bidens connata, Vernonia altissima, Phacelia bipinnatifida, P. Purshii, Euphorbia obtusata* and *Habenaria virescens.* But for the presence of these plants there is no difference between the talus on either side. It is to be noted, however, that large springs, notably Falling Spring, issue from the face of the Illinois bluff, permitting the existence of numerous liverworts and algae. The occurrence of *Chlorotylium mamillosum,* which covers the rocks at Falling Spring with a green felt, is to be noted here.

The cliff.

Like the talus, the cliff surface above it shows certain differences when compared with that of the Missouri bluffs. Frequently the shrubs reach up to the top of the bluff. This is well shown by the occurrence, in the upper part, of *Delphinium tricorne* and *Arabis laevigata,* plants which on the Missouri side are limited to the more shaded localities. However, in such portions as are exposed, the flora presents a rosette formation not differing materially from that on the Missouri side.

THE ILLINOIS PLATEAU.

The wooded area.

The woods of the Illinois plateau, composed mainly of deciduous oaks, resemble generally those of the Missouri plateau. They appear to be somewhat richer in species. On the whole they seem to be moister. *Hepatica acutiloba,* seldom encountered near Jefferson Barracks, though plentiful at Meramec Highlands, is frequently met with in the Illinois woods. The same is true for *Anemone pennsylvanica,* curiously enough known only from the dry bottom on the Missouri side. *Gentiana Andrewsii* thus far has not been found near Jefferson Barracks.

Open hillside.

This supports but little shrubbery, which, if occurring at all, is composed mainly of *Rhus glabra.* Grasses are dominant, *Poa pratensis* being the principal species. It is accompanied by *Agrostis scabra, Andropogon furcatus, A. scoparius, Aristida oligantha, Bromus secalinus, Danthonia spicata, Eatonia obtusata, Festuca tenella, Muhlenbergia sobolifera, Panicum sanguinale, Phleum pratense, Poa annua,* and *Vilfa aspera.* During the spring a number of low growing plants occur, such as *Ranunculus fascicularis, Capsella Bursa-pastoris, Lepidium virginicum, Viola Rafinesquii, Malva rotundifolia, Linum virginianum, Fragaria virginiana,* rosettes of *Oenothera biennis* and of various Compositae, of which, at this time, *Achillea Millefolium* and *Antennaria plantaginifolia,* are most frequent, and further, *Androsace occidentalis, Verbena angustifolia, V. bracteosa* and *V. urticaefolia, Comandra umbellata, Rumex Acetosella* and *Hypoxis erecta.* Later are added *Abutilon Avicennae, Linum sulcatum,* numerous Leguminosae, *Gaura biennis,* species of *Aster* and *Solidago, Gerardia tenuifolia, Monarda punctata, Croton capitatus* and *C. monanthogynus.*

Creek banks.

The greater portion of the Illinois plateau having been brought into cultivation, the presence of a small stream is at once patent to the eye on account of the numerous trees and shrubs which line its banks. The principal trees are *Tilia americana, Acer dasycarpum, A. rubrum, A. saccharinum, Negundo aceroides, Cercis canadensis, Gleditschia triacanthos, Gymnocladus canadensis, Fraxinus americana, F. viridis, Celtis occidentalis, Morus rubra, Ulmus americana, Platanus occidentalis, Carya amara, C. olivaeformis, Betula nigra, Carpinus caroliniana, Quercus macrocarpa, Salix cordata* × *sericea* and *Salix nigra.* Smaller trees and shrubs occurring here are *Asimina triloba, Ptelea trifoliata, Rhamnus lanceolata, Staphylea trifolia, Amelanchier canadensis, Prunus americana, P. serotina* and *P. virginiana, Pyrus coronaria, Hydrangea arborescens, Cornus asperifolia, C. paniculata, Sambucus canadensis, Symphoricarpus vulgaris, Viburnum Lentago, Forestiera acuminata, Corylus americana* and *Celtis mississippiensis.* Vines are numerous, especially *Ampelopsis quinquefolia, Cissus Ampelopsis, Vitis cinerea, V. cordifolia,* and *V. riparia* as well as *Rhus Toxicodendron. Menispermum canadense, Convolvulus Sepium* and *Ipomoea pandurata* are frequently encountered. *Clematis virginiana* is not rare. Near the water *Echinocystis lobata* and *Sicyos angulatus* occur in places.

In spring there is developed an abundant rosette flora chiefly composed of Ranunculaceae and Liliaceae. *Anemonella thalictroides, Isopyrum biternatum, Ranunculus abortivus* and *R. septentrionalis, Thalictrum purpurascens, Podophyllum peltatum, Sanguinaria canadensis, Dicentra Cucullaria, Sanicula marylandica canadensis, Trillium recurvatum, T. sessile* and *Uvularia perfoliata* are the most common. *Arisaema Dracontium* and *A. triphyllum* are everywhere. Among the Carices, *C. Davisii, C. granularis, C. laxiflora* and *C. Shortiana* are the most frequent. *Cyperus erythrorhizos* and *Poa pratensis* are everywhere at this time. Of ferns, the principal ones are *Adiantum pedatum* and *Cystopteris fragilis.* While early summer does not make any great changes in the vegetation, there is a gradual change with the seasons so that in late summer and early fall one finds that Compositae and Labiatae have taken possession.

The prairie.

The prairie flora on the Illinois side does not differ materially from that on the Missouri plateau. In spring a number of grasses make their appearance, especially *Agrostis alba, A. scabra, Danthonia spicata, Elymus striatus, Phleum pratense* and *Poa pratensis.* Rosette-forming species appear along with these. *Capsella Bursa-pastoris, Sisymbrium officinale, Oenothera biennis, Erigeron annuus, E. canadensis* and *E. philadelphicus, Taraxacum officinale, Veronica arvensis, Verbena stricta* and *V. urticaefolia* are among the most frequent and most striking. Other species appearing at this time are *Anemonella thalictroides, Ranunculus fascicularis, Draba caroliniana, Geranium carolinianum, Oxalis stricta, Polygala verticillata, Amorpha canescens, Astragalus mexicanus, Stylosanthes elatior, Triosteum angustifolium* and *T. 'perfoliatum, Houstonia angustifolia, Chrysopsis villosa, Parthenium integrifolium, Silphium integrifolium*, and *Phlox pilosa.* These practically form the spring flora together with those plants whose rosettes have been striking features during the winter months. Among them *Lechea major* and *L. minor, Achillea Millefolium, Cnicus pumilus* and *Plantago Rugelii* are to be noted especially. Nor should mention of the presence of clumps of *Opuntia Rafinesquii* and of *Monarda fistulosa* be omitted.

The summer sees a large addition to the species above mentioned, the new species being derived especially from the Leguminosae and Compositae as shown by the distribution tables. During the autumn Compositae are most prominent, especially several species of *Aster* and *Solidago.*

INTRODUCED PLANTS.

The introduced plants are found chiefly in three localities, *i.e.*, in the vicinity of dwellings, in parks and nurseries, and on the railroad right of way. Among the railroad immigrants must be placed the following: *Clematis crispa* (S. U. S.), *Argemone alba* (W. and S. W. U. S.), *Argemone platyceras* (W. and S. W. U. S.), *Sisymbrium altissimum* (S. U. S.), *Cleome integrifolia* (W. U. S.), *Polanisia graveolens* (brought to the railroad rights of way along the Mississippi, both in St. Louis county and in the Illinois section, with railroad ballast obtained from the Meramec River gravel bars), *Bergia texana* (W. U. S.), *Tribulus grandiflorus* (S. E. U. S.), *Indigofera leptosepala* (S. U. S.), *Petalostemon villosus* (W. U. S.), *Medicago lupulina* (E. U. S.), *Matricaria discoidea* (N. California and Oregon), *Verbesina encelioides* (W. U. S.), *Linaria vulgaris* (E. U. S.) and *Sorghum halepense* (E. U. S.).

Three plants are to be listed as "river immigrants." They are *Pluchea camphorata* (E. U. S.), *Martynia proboscidea* (W. U. S.) and *Verbesina encelioides* (W. U. S.), already mentioned as a railroad immigrant.

In regard to the acclimatized cultivated plants, *Brassica alba* and *B. nigra*, as well as *Nasturtium officinale* and *N. Armoracia*, *Raphanus sativus*, *Pastinaca sativa*, *Cichorium Intybus*, and *Asparagus officinalis*, are plants of the kitchen-garden and usually found around dwellings, though some, like *Brassica alba*, *B. nigra* and *Asparagus officinalis*, may be found at a considerable distance from human habitations. *Delphinium Ajacis*, *Saponaria officinalis* and *Hemerocallis fulva* are escaped ornamental garden plants. The latter species is found in great abundance along roadsides in the vicinity of Jefferson Barracks. *Lamium amplexicaule*, one of the earliest weeds to flower here, is found especially near greenhouses, lasting almost throughout the year. Another plant, similarly limited to the vicinity of greenhouses, but which thus far has been found only in the city of St, Louis, is *Galinsoga parviflora;* it may become a troublesome weed. *Ballota nigra* is found here and there in waste places. *Prunus Persica* is especially abundant on the plateau at Jefferson Barracks, bordering the roads and foot paths. *Ailanthus glandulosus*, *Robinia hispida* and *R. Pseudacacia* are trees which easily spread in the vicinity of dwellings. The effect of wind upon distribution is well shown in the case of the latter species. The escape of the various plants used as cattle food is too well know to discuss further. Neither need it be pointed out that the various aromatic plants used as condiments and commonly grown in kitchen-gardens have escaped in the vicinity of dwellings, though it may be of interest to note that such escapes are most frequent in the vicinity of dwellings occupied by people of German origin. Such plants are *Coriandrum sativum, Foeniculum officinale, Marrubium vulgare, Melissa officinalis* and *Nepeta Cataria. Fagopyrum esculentum* and *Cannabis sativa* frequently are found in waste places where they maintain themselves against great odds. *Cichorium Intybus* which, according to Pammel*, was introduced near Dorchester, Mass. in 1875 and since then has spread chiefly through the northern states, is frequent along the roadsides on the Illinois plateau, an evident escape from cultivation. As transient garden escapes are to be considered *Nymphaea reniformis, Citrullus vulgaris, Citrullus ovifera pyriformis, Centaurea Cyanus, Coreopsis tinctoria, Matricaria Chamomilla, Nicandra physaloides* and *Zea Mays.*

The transient weeds are *Argemone alba, Argemone platyceras, Camelina sativa, Sisymbrium altissimum, Cleome integrifolia, Hibiscus Trionum, Medicago lupulina, Petalostemon villosus, Pluchea camphorata, Martynia proboscidea* and *Phalaris canariensis.* Naturally there are a number of other plants which from time to time are introduced through the agency of man, especially among nursery stock. Such plants are most frequently met with in parks and nurseries but are not of sufficiently frequent occurrence to attract attention, the number of individuals being limited. An exception to this rule proved one of the Cyanophyceae, determined by Professor W. A. Setchell as *Oscillatoria Agardhii,*† and new to North America, specimens of which occurred in so large quantities in one of the ponds of the Missouri Botanical Garden, as to form a water bloom. The pond in which these plants were found communicates by a drain with the ponds of Tower Grove Park and it is more than probable that the plant was introduced with water lilies obtained for the park from eastern dealers who imported European stock.

The introduced established weeds include *Clematis crispa, Delphinium Consolida, Chelidonium majus, Sisymbrium of-*

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* Pammel, L. H. Ecology. 335. 1903.

† Collins, F. S., I. Holden and W. A. Setchell. Phyc. Bor. Amer. **30**: 1451. 1908.

ficinale, Polanisia graveolens, Lychnis Githago, Silene media, Abutilon Avicennae, Tribulus grandiflorus, Dalea alopecuroides, Glycyrrhiza lepidota, Indigofera leptosepala, Melilotus alba, Melilotus officinalis, Daucus Carota, Dipsacus sylvestris, Chrysanthemum Leucanthemum, Lactuca Scariola, L. Scariola integrata, Matricaria discoidea, Verbesina encelioides, Linaria vulgaris, Solanum rostratum, Ballota nigra, Lamium amplexicaule, Leonurus Cardiaca, Alopecurus geniculatus, Bromus secalinus, Dactylis glomerata, Eleusine indica, Hordeum jubatum, Panicum sanguinale, Poa annua, Poa compressa, Poa pratensis, Setaria glauca, Setaria italica, Setaria viridis and *Sorghum halepense.* It is probable that seed of each of these species was introduced repeatedly, of some more recently, of others earlier. Among the latter must be classed *Lactuca Scariola integrata,* sometimes designated by American authors as *L. Scariola* and again as *L. virosa.** This entire leaved form, which is entirely distinct from the European *L. virosa,* was introduced into Missouri from Illinois. According to Mr. J. H. Kellogg, it was plentiful in the American Bottom thirty years ago. Some ten years later its occurrence on this side of the Mississippi was noted. Since then it has spread to an enormous extent, being one of the principal weeds of roadsides and empty lots. During the summer of 1907 Dr. Trelease noted the appearance, west of St. Louis, of the cut-leaved form, the true *L. Scariola.* During the same year the plant was found in numerous localities in the vicinity of St. Louis but not in the city itself. This year, 1908, there has been a marked increase in the number of individuals of *Lactuca Scariola* as well as in the number of localities where the plant was encountered. It has also made its appearance on lots well within the city limits.

The plants which have escaped from cultivation and have become established are *Delphinium Ajacis, Brassica alba, B. nigra, Nasturtium Armoracia, N. officinale, Raphanus sativus, Saponaria officinalis, Linum usitatissimum, Ailanthus glandulosus, Medicago sativa, Robinia Pseudacacia, Trifolium hybridum, T. pratense, T. repens, Vicia sativa, Prunus Persica, Coriandrum sativum, Foeniculum officinale,*

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* Dewey, L. H. Identity of Prickly Lettuce. Rhodora. 7 : 9. 1905.

Pastinaca sativa, Cichorium Intybus, Marrubium vulgare, Melissa officinalis, Nepeta Cataria, Fagopyrum esculentum, Cannabis sativa, Humulus Lupulus, Asparagus officinalis, Hemerocallis fulva, Agrostis alba, Avena sativa and *Phleum pratense.*

PHENOLOGY.

Geographical position, especially latitude, determines largely the nature of the plant growth and the flowering and fruiting seasons as well as other phenological phenomena.* As shown by De Candolle† by experiments with both herbaceous and woody plants, vegetation is more powerfully or promptly acted upon by the rising spring temperature in higher than in lower latitudes. Subordinate, but of greatest local influence, is physiography since indirectly, in determining the nature of the associations, as well as directly, it modifies the temperature and the humidity of air and soil, the air currents, and the intensity and amount of light together with the chemical and physical conditions, including color, of the soil. Each of these factors plays a part in the bringing about of phenological phenomena, though temperature is probably the most important. However, to heat alone the earlier or later date of flowering can not be ascribed. A striking instance is yielded by the agaves of the island Lesina in the Adriatic, which did not flower during 1889, something entirely

TABLE L.

MONTH	FLOWER	FRUIT
March	24	0
April	134	0
May	334	50
June	338	141
July	395	223
August	384	341
September	229	437
October	59	262
November	14	45

SPECIES FLOWERING AND FRUITING, BY MONTHS.

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* Schwendener, S. U. Ueber die periodischen Erscheinungen der Natur insbesondere der Pflanzenwelt. Zurich. 1856.

† De Candolle, A. Des Effets différents d'une même Température sur une même Espèce au Nord et au Midi. Compt. Rend. **80.** 7 Je. 1875.

unusual and which the temperature conditions would not have led one to expect.* On the other hand, at the Missouri Botanical Garden, it has been observed every spring that in the portion of the tulip beds facing the south, the bulbs placed in the outer row, where the slope of the soil is nearer the perpendicular, always flower several days earlier than do the others.

TABLE M.

FAMILIES	Mr	Ap	My	Je	Jl	Ag	S	O	N
Ranunculaceae	2	11	25	16	7	2	1	0	0
Cruciferae	4	14	20	16	9	5	3	3	1
Leguminosae	1	5	11	28	33	27	10	3	0
Rosaceae	0	14	30	13	9	2	2	0	0
Onagraceae	0	0	2	7	13	10	5	0	0
Umbelliferae	1	4	10	11	10	5	1	0	0
Compositae	0	4	14	19	45	72	69	13	1
Asclepiadaceae	0	0	2	6	9	5	0	0	0
Convolvulaceae	0	0	0	1	6	8	7	0	0
Solanaceae	0	0	1	3	9	7	4	3	0
Scrophularineae	0	3	5	9	8	12	9	1	0
Verbenaceae	0	1	2	7	9	8	5	1	0
Labiatae	1	2	7	11	21	20	9	0	0
Amaranthaceae	0	0	0	2	4	2	3	0	0
Chenopodiaceae	0	0	0	1	5	7	4	1	1
Polygonaceae	0	0	5	7	15	16	8	1	1
Euphorbiaceae	0	0	1	3	9	14	6	3	2
Liliaceae	0	6	9	6	0	0	0	0	0
Cyperaceae	0	4	28	33	25	20	12	3	0
Gramineae	0	1	13	23	25	30	22	10	1

SPECIES OF IMPORTANT FAMILIES IN FLOWER, MARCH TO NOVEMBER.

It must be remembered in this connection that tulips, by winter, have formed the next year's leaves and flowers and that this development has advanced so far that even the pollen mother cells have divided. Similar conditions are exhibited by many of the more familiar spring flowering species such as *Anemone Hepatica, Sanguinaria canadensis, Asarum canadense, Arisaema triphyllum* and others.† In such cases the time of flowering evidently depends in a measure on the climatic conditions of the summer and fall preceding as influencing the development of the flower buds. Some, like *Aralia quinquefolia,* even form the bud, which produces the flowering stalk in June or July, two years earlier. Contrary to what one would be led to expect, the flowering period is rather late. Trees respond readily to a greater amount of heat. It is a matter of yearly observation that the flower buds of those branches of *Acer* facing the south open as much as two weeks earlier than those which face the north. Similarly, rosettes of biennials and perennials which during the winter have been kept in greenhouses or frames blossom much

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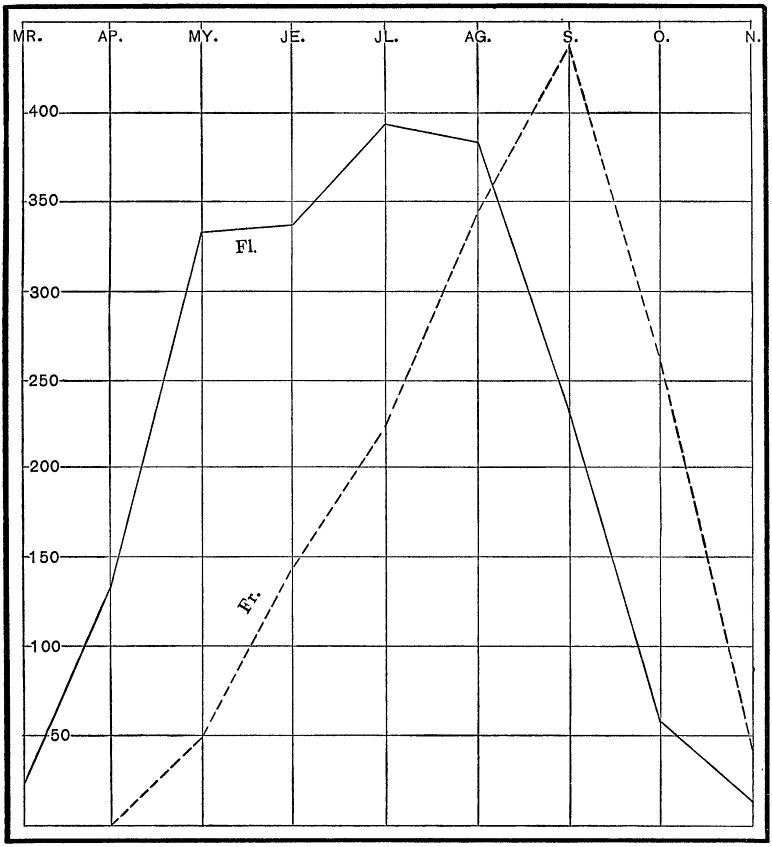
* Gunther, S. Die Phänologie. Natur und Offenbarung. 41. 1895.

† Foerste, A. F. The Hibernacula of Herbs. Am. Nat. **17** : 1107. 1883.—Why Flowers Blossom Early. Am. Nat. **19** : 301. 1885.

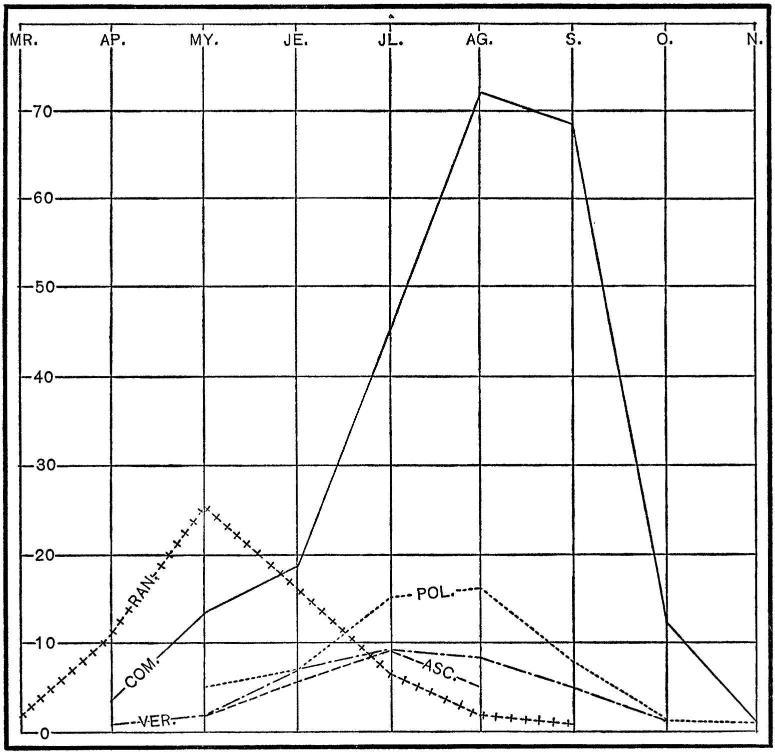
DIAGRAM 1.



SPECIES FLOWERING AND FRUITING, THROUGH SEASON.

earlier than those which have remained outside. To such a cause is ascribed the flowering, in June, of *Lobelia cardinalis*, noted by Mr. Irish.* This seems correlated with the fact that where biennials, such as *Digitalis purpurea*, have been sown so late in the fall that during the next year they produced no flowers, they in the spring following will flower very early, the flower stalks being short and the flowers small. This early flowering would by some be ascribed to a large amount of food being stored in the root, by others to the plant having received more than a definite number of heat units,

DIAGRAM 2.



FLOWERING OF FAMILIES, THROUGH SEASON.

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* Irish, H. C. Comparative Phenological Notes. Rept. Mo. State Hort. Soc. **40**: 325. 1897.

denoted the physiological constant. The same explanation probably holds good for those rosettes of biennials which develop an inflorescence far in advance of others. Observations on *Lactuca Scariola integrata* have shown that the rosettes formed early in the fall were the first to bloom during the following year.

A smaller amount or a lesser intensity of light seem to cause a delay in the appearance of the flower, a matter of common observation in horticultural establishments. It is shown also by the behaviour of representatives of a species occurring both in the open and in the woods, though in the latter case a lower temperature and increased humidity, both of soil and air, play a part. That a greater degree of soil moisture, alone or practically alone, delays the flowering period is shown by a comparison of individuals of the same species in dry situations and in moister surroundings. The wet and the dry portions of the American Bottom yield numerous instances. Drought will cause an early appearance of the flower, a fact well known to florists and made use of by them when preparing potted plants for market.

Phenological phenomena further depend on individual characteristics and state of health of the tree or plant and, as shown in the case of fruit trees, but probably applicable to other plants also, on the heavy or light fruiting in the year previous to flowering.* Some plants, under apparently identical conditions, vary greatly in respect to flowering seasons. Specimens of *Hamamelis virginiana*, properly flowering during the autumn, frequently do so in spring, others, in the immediate vicinity, behaving normally. Some will flower even both in fall and spring.

Different species are not influenced to the same extent by changes of temperature, giving rise to cases of inversion, *i. e.* where a species which normally flowers later than another does so earlier.† Again, under proper climatic conditions, plants which in one region are annuals may become peren-

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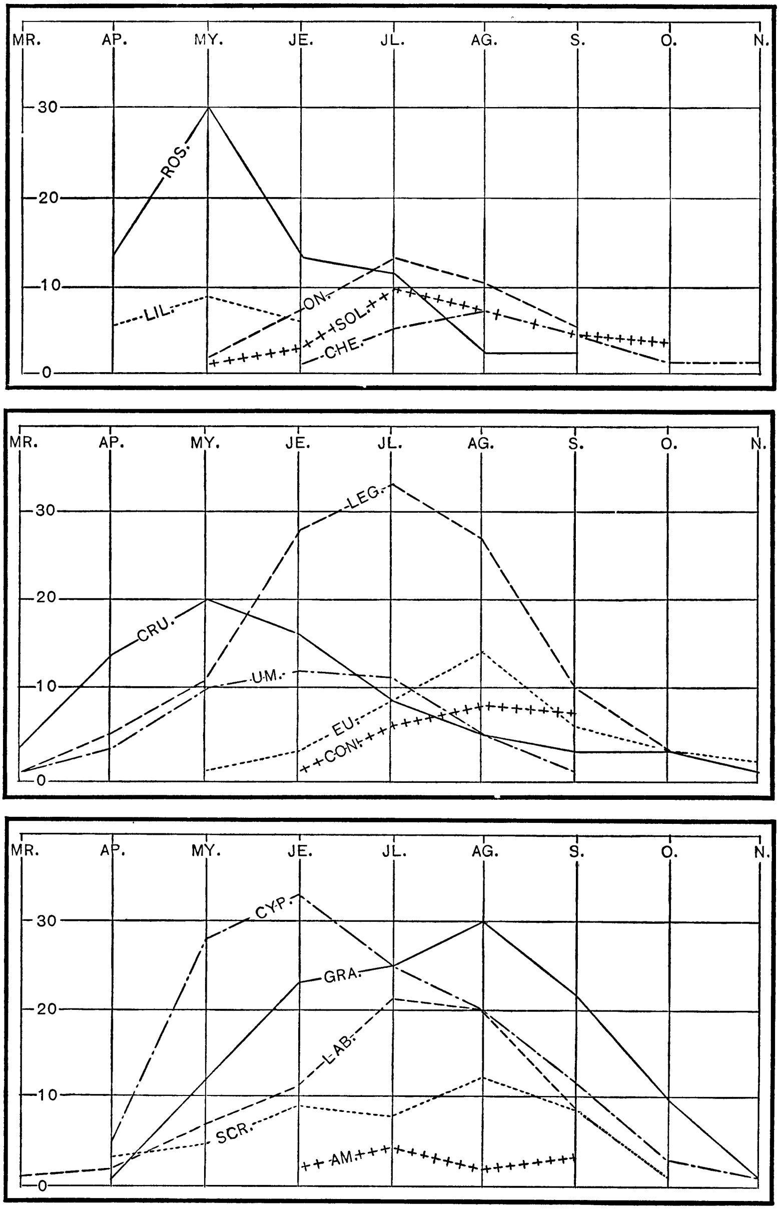
* Sandsten, E. P. Conditions which affect the Time of the annual Flowering of Fruit Trees. Wisconsin Agric. Exp. Sta. Bul. **137** : 7. 1906.

† Rahn, L. Ueber phänologische Inversionen. Ber. Oberhess. Ges. Nat. und Heilk. **21** : 114. 1882.

DIAGRAM 3.



FLOWERING OF FAMILIES, THROUGH SEASON.

nials, as shown by the perennial nature of the tomato and the geranium and *Lantana Camara* in California as contrasted with conditions prevailing at St. Louis.

A comparison of various phenological data leads to the conclusion that as a rule there is little variation, in the different parts of the country, in regard to the appearance of the flowers in the case of those plants which are summer flowering. The early flowering plants show the greatest variation. Conditions in North America are best expressed in the words of Trelease:*

"In a country covering nearly twenty-five degrees of latitude and fifty-five of longitude, with lofty mountains and tablelands and low valleys, diversified by great lakes and rivers, and embracing every variety of climate from the subtropical to the subarctic, with excesses of humidity in one region and of drought in another, it is impossible to arrange the phenomena of the seasons so as to include the whole.

"On comparing the data obtainable, however, a few general features are found common to a great part of the country. Whatever their exact date of leafing or flowering may be, there are certain genera—like the maples, poplars and elms among trees, and the violets and wake robins among herbs—that precede most of their fellows; and, except in very anomalous seasons, their species succeed each other with the same regularity. Where the same plant extends from the Gulf to New England, it naturally blooms earlier in the warmer region; but it is noticeable that the difference, greatest in the flowers of early spring, becomes less marked as the season advances, under the accelerating heat of the northern summer, so that there is often little difference in the flowering of summer and autumnal plants. In general the same rule applies to species occurring over a considerable range of altitude, and is now and then illustrated nicely by a species with a wide distribution on both high and low ground."

From the above will be gathered the desirability of the making of a large number of accurate observations such as

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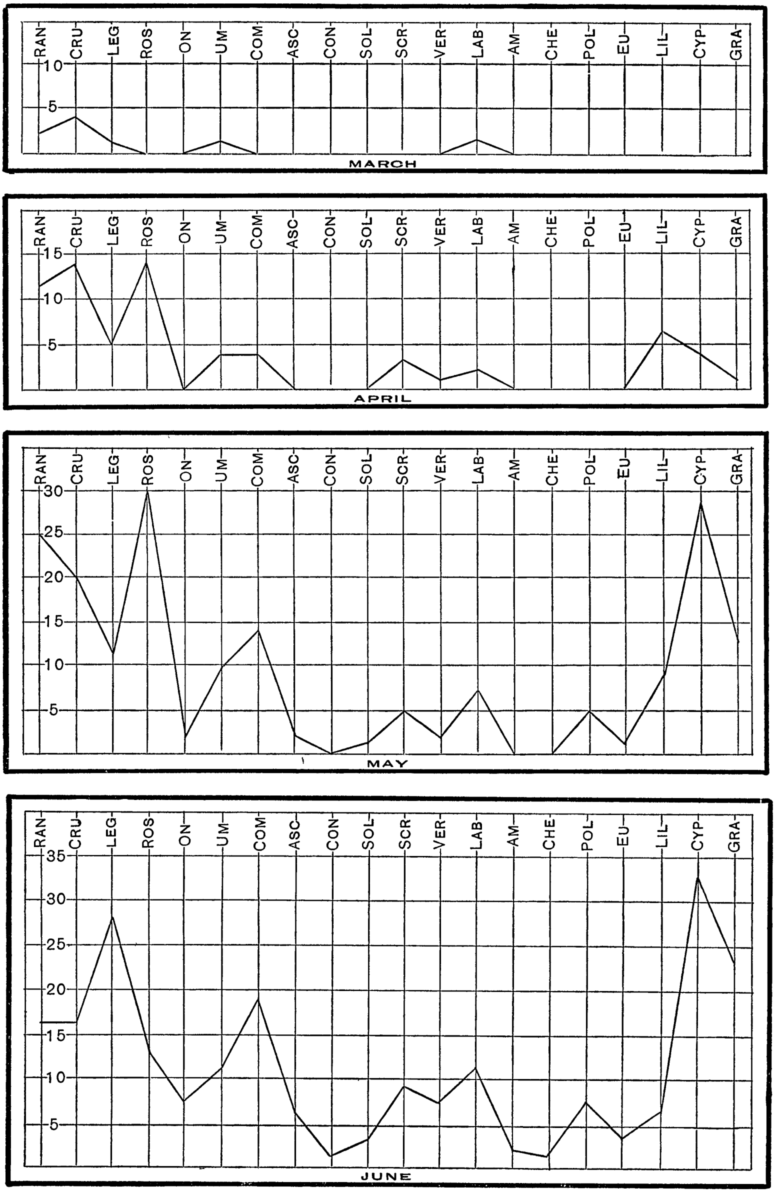
* Trelease, W. Blooming Times for Flowers. Science Almanac. 5. 1885.

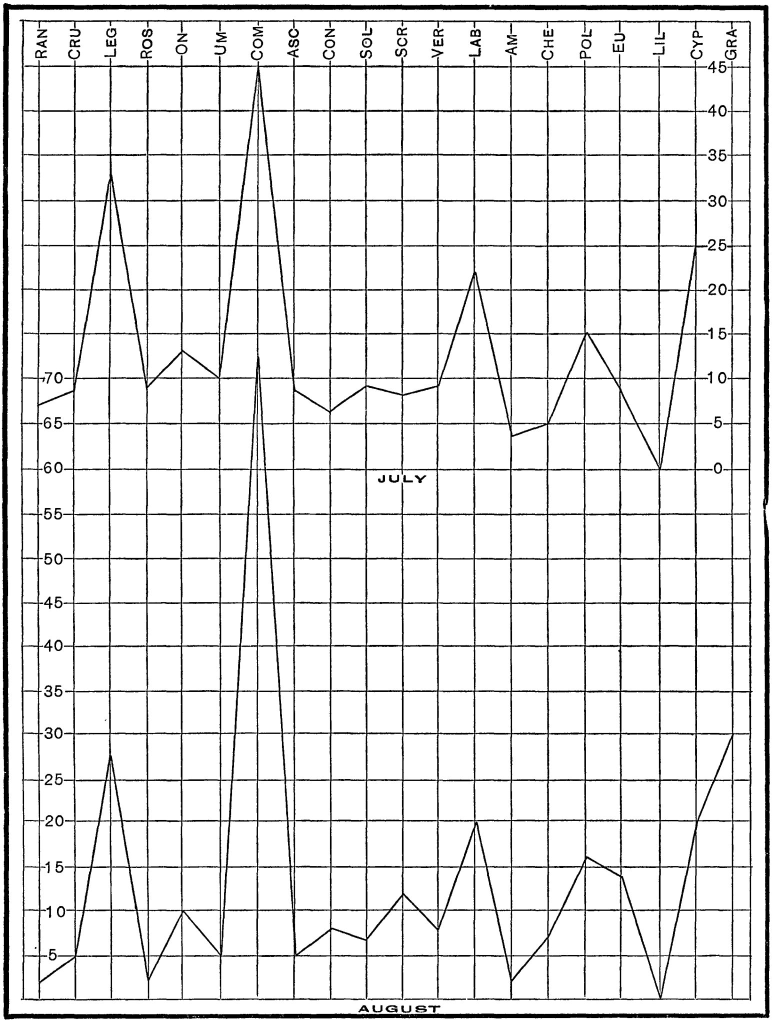
DIAGRAM 4.



FLOWERING OF FAMILIES, BY MONTHS.

those of Craig,* but on a larger scale and in every part of the country, together with observations on light intensity based

DIAGRAM 5.



FLOWERING OF FAMILIES, BY MONTHS.

on a uniform standard, and, where not already provided for, the usual meteorological observations. Such attempts have been made from time to time in the United States, but nowhere appears to have been attained that perfection shown by the data gathered under the auspices of the Botanical Club of Canada, for a great part by pupils of public schools, or those published by the forest-phenological stations of Germany.

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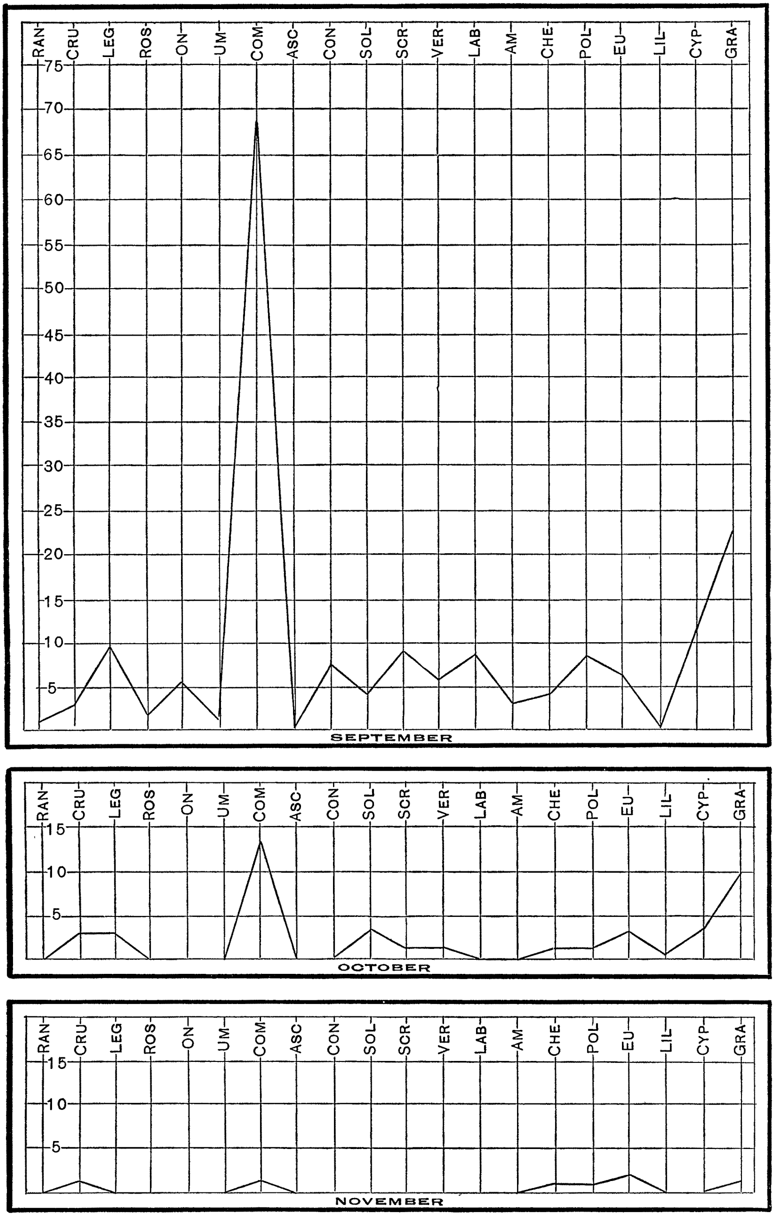
* Craig, M. A Catalogue of the uncultivated Flowering Plants growing on the Ohio State University Grounds. Ohio Agric. Exp. Sta. Bull. tech. ser. 1^2 : 49. 1890.

In regard to the plants enumerated in the distribution and phenological tables following, a few points are to be noted here. Some never set fruit, as *Nasturtium Armoracia* and *Apios tuberosa.* Others, and this applies to the most common weeds, appear with varying frequency in successive years. *Portulaca oleracea* is very plentiful during the present year as it was in 1906 while during 1907 it was far less of a pest. Opposed to this is *Ellisea Nyctelea* which was very plentiful in 1907, covering large patches to the exclusion of all other species. While both in 1906 and in the spring of the present year a large number of plants of this species were observed, the species was by far not so abundant as during the intervening year. Interesting is in this connection the appearance of *Commelina communis* at St. Louis, this being the first time it has been reported from this locality. The writer first noticed the plant in his seedpans in large numbers in the spring of 1908. During the previous years this had not been the case, probably because only isolated individuals appeared. Later in the season the plant was found as a common weed in various parts of the Missouri Botanical Garden. Its identity with similar plants which, in lesser numbers, had occurred the previous year was established through some plants raised from seed obtained in one of the localities during 1907. If the occurrence of the plant had been limited to the Missouri Botanical Garden the explanation that there it had escaped from cultivation would probably have been accepted as valid. But during the spring and summer of 1908 the appearance of the plant was noted in a number of private gardens in different parts of St. Louis. Inquiry revealed the fact that though in some instances the plant had been observed during 1907 it had not been observed previously. Hence it is probable that the plant was introduced in St.

DIAGRAM 6.



FLOWERING OF FAMILIES, BY MONTHS.

Louis some years ago but up to 1907 did not find conditions favorable to the production of a large quantity of seed. However, since *Commelina communis* produces large quantities of seed with the utmost ease, the alternative view might be taken that the conditions for germination were exceptionally favorable during the spring of 1908 and that to this must be ascribed its frequency during the present year. The same explanation would apply to the frequency of any one weed during a certain year.

The distribution and phenological tables give the names of a number of plants occurring in the section under discussion. The nomenclature of Gray's Manual 6 ed. has been followed. The list is not complete but merely aims to give the principal plants. It includes some 850 species, being 50% of the phanerogams and vascular cryptogams occurring within a radius of twenty miles from St. Louis. The present list is based primarily on the writer's collections extending over a period of three years as well as on the extensive collections of local plants preserved in the herbarium of the Missouri Botanical Garden, notably the collections of the late Dr. Engelmann and the late Henry Eggert. An attempt has been made to give the distribution of the different species over the various physiographic regions met with in an ideal cross section of the Mississippi south of St. Louis. Under each of these regions the various modifications have been indicated by different numbers, the number being repeated where the modification is analogous. Under a separate main caption weeds have been listed, their distribution being identical on both sides of the river. Thus 1 indicates cultivated fields, 2 the vicinity of dwellings, 3 pastures, 4 roadsides, 5 roadside and railroad ditches, 6 creek banks, 7 hillsides, 8 hilltops, 9 limestone glades, 10 sinkholes, 11 ponds or lakes, those lakes of the American Bottom which occur near the bluff being indicated by $\underline{11}$, 12 prairies, the same number being used to indicate the bottom lands, $\underline{12}$ denoting the dry bottoms, 13 thickets, 14 woods, 15 cliffs, 16 talus, 17 ravines, 18 railroad embankments, and the strip adjacent the tracks, 19 railroad cuts, 20 mud covered shores, 21 river islands, 22 mudflats, 23 sandy shores and 24 ballasted railroad tracks. By means of different symbols it has been attempted to show when the plant is prominent. This depends not only on the stature of the plant itself and upon the color of its flowers but also on the ecological relations, especially the degree of development of others associated with it. The seasons are indicated as follows: | spring, + spring and summer, – summer, ± spring, summer, autumn, × summer and autumn, = autumn, * spring, summer, autumn, winter. Where the symbol ‡ accompanies any of the above it indicates that the plant forms a striking feature of the winter aspect. The symbol † accompanying any of the above indicates that the plant has two flowering periods. The latter will be found on the pages bearing even numbers and are indicated by the abbreviated names of the months. Thus Fl, Je, Jl indicates that the plant flowers in June and July. Where the names of the months are separated by the symbol & it means there are two distinct flowering periods as is further evident from the presence of the symbol † in other columns. The same applies to the fruiting periods indicated on the odd numbered pages. As fruiting period is recognized the time when the fruit is ripe or almost so and sufficiently advanced to form a representative herbarium specimen. In cases where the fruit stays on throughout the winter this is indicated by giving the last month of fruiting as December. For convenience in correlating the data on opposite pages the species have been numbered consecutively, the numbers being repeated on each page.

As shown by the tables and accompanying diagrams 1 to 6, even in May a considerable proportion of the local species is in flower. During the next three months this average is maintained with but slight fluctuation. In view of the fact that there is a marked increase in the number of Compositae in flower during August and September it is evident there must be a decrease in other families. This is clearly shown by the diagrams. While the Ranunculaceae and Rosaceae decrease in numbers, the Compositae increase. It is also noted that the Cyperaceae attain their maximum in June while the Gramineae do so only in August. July and August show the greatest number of species in flower.

DISTRIBUTION AND PHENOLOGY		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Actaea alba	1							+		Fl	My	Je			
Anemone caroliniana	2							+		Fl	My	Je			
Anemone pennsylvanica	3									Fl	Je	Jl			
Anemone virginiana	4						×			Fl	Je	Jl			×
Anemonella thalictroides	5	+							+	Fl	Mr	My	+		+
Aquilegia canadensis	6									Fl	My	Je			
Cimicifuga racemosa	7									Fl	Je	Jl		+	+
Clematis crispa	8									Fl	My	Je			
Clematis Pitcheri	9									Fl	My	Je			
Clematis virginiana	10									Fl	Je	Jl			
Delphinium Ajacis	11									Fl	Je	Jl		+	
Delphinium tricorne	12						+	+		+	Fl	Ap	My	+	+
Hepatica acutiloba	13									Fl	Mr	Ap			
Hydrastis canadensis	14							+		Fl	+	Ap	My	+	+
Isopyrum biternatum	15									Fl	Ap	My			
Myosurus minimus	16	|		|	|					Fl	Ap	My	|		
Ranunculus abortivus	17	±	±	±	±	±	±		Fl	Ap	S	±			
Ranunculus abortivus Harveyi	18						±			Fl	Ap	S			
Ranunculus fascicularis	19				|			|	|	Fl	Ap	My			|
Ranunculus multifidus	20									Fl	Ap	S			
Ranunculus oblongifolius	21									Fl	My				
Ranunculus recurvatus	22									Fl	Ap	My			
Ranunculus repens	23						±			Fl	Ap	Ag			
Ranunculus septentrionalis	24						±	±		Fl	Ap	Jl			
Thalictrum purpurascens	25									Fl	Je			+	+
Asimina triloba	26						*			Fl	Ap	My			
Menispermum canadense	27						±	±		Fl	My	Je		±	±
Podophyllum peltatum	28						+	+		Fl	My	Je		+	+
Nelumbo lutea	29									Fl	Jl	Ag			
Nuphar advena	30									Fl	My	Ag			
Nuphar advena minus	31									Fl	My	Ag			
Nymphaea odorata	32									Fl	My	S			
Sanguinaria canadensis	33						|	|	|	Fl	Mr	Ap		|	|
Stylophorum diphyllum	34									Fl	My				
Corydalis aurea	35						|	|		Fl	Ap	My			|
Dicentra Cucullaria	36									Fl	Mr	Ap			
Arabis canadensis	37									Fl	Je	Jl			
Arabis confinis	38									Fl	Ap	Je			
Arabis dentata	39									Fl	Ap	My			
Arabis hirsuta	40	|								Fl	Ap	My			
Arabis laevigata	41							+		Fl	Ap	My			
Arabis ludoviciana	42									+	Fl	Ap	My		
Arabis lyrata	43									Fl	Ap	My			
Brassica alba	44		×							Fl	Je	Jl			
Brassica campestris	45				+					Fl	My	Je			
Brassica nigra	46	—			—					Fl	Je	Jl			
Brassica Sinapistrum	47	+								Fl	My	Jl			
Camelina sativa	48	+								Fl	My	Je			
Capsella Bursa-pastoris	49	*	*	*	*	*	*	*	*	Fl	Mr	N	*	*	*
Cardamine hirsuta	50	|				|				Fl	Ap	My			
Cardamine rhomboidea	51									Fl	My	Ag			
Dentaria laciniata	52									Fl	Ap	My			

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
		+										1				Fr	Jl	Ag						+			
												2				Fr	Ag	S					+				
							×					3				Fr	Jl	×	×		×			×			
	×	×										4				Fr	Ag	S				×	×	×	×		×
	+	+										5				Fr	Je	Jl				+	+	+	+		+
+		+										6				Fr	Jl	Ag					+				
												7				Fr	Jl	Ag						+			
				±								8				Fr	Ag	S									
	±											9				Fr	Ag	S				±					
	±						±					10			Fr	S	O	±				±					±
	+	+										11				Fr	Jl										
	+	+										12				Fr	My	Je				+				+	
												13				Fr	My	Je						|			
												14				Fr	Jl		+			+		+			
												15			Fr	Je	+										+
							|	|				16			Fr	My	|	|		|							
	±	±		Fr	My	O	±	±				17		±	±	±	±	±	±		±	±		±			±
		±										18				Fr	My	Je									
												19				Fr	My	Je						|	|	|	
												20				Fr	My	O	×								
												21					+	Fr	Jl								
		|										22				Fr	My	Je						|			
		±		Fr	My	S		±				23				±		±	±			±					
	±	±		Fr	My	Ag		±				24				±	±	±	±			±					±
												25				Fr	Jl	Ag		+				+			+
	*	*						*				26				Fr	S	O				*					*
	±											27			Fr	S	D	±				±		±			±
	+	+										28				Fr	Ag	S				+		+			+
												29				×	Fr	Ag	O								
												30				×	Fr	Jl	S								
												31				Fr	Jl	S	×								
												32				×	Fr	Je	O								
	|	|										33				Fr	My	Je				|		|			|
												34				Fr	Jl					—					
				|	|							35				Fr	My	Je		|							
	|											36				Fr	My	Je				|		|			|
×		×										37			Fr	Jl	S	×					×				
												38				Fr	My	Jl				+					
		+										39				Fr	My	Je	+			+		+			+
	|											40				Fr	My	Je				|		|			
												41				Fr	My	Jl					+	+			
+												42				Fr	My	Ag					+				
												43				Fr	My	Je					|				
												44				Fr	Jl	Ag									
												45				Fr	Je	Jl									
				—								46				Fr	Jl	Ag		—							
												47				Fr	Je	Ag									
												48				Fr	Je	Jl									
*	*	*	*	*	*		*	*	*	*	*	49		Fr	*	Ap	*	*	D	*	*	*	*	*	*	*	*
												50				Fr	My	Je									
												51	+			+	Fr	Jl	Ag								
	|	|										52			Fr	My	Je	|				|		|			

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Draba brachycarpa	1									Fl	Ap				|
Draba caroliniana	2	|								Fl	Mr	Ap			
Draba cuneifolia	3									|	Fl	Mr	My		
Erysimum asperum	4									Fl	Ap	My			
Lepidium intermedium	5									Fl	My	O			
Lepidium virginicum	6	±	±		±					Fl	My	O	±		
Nasturtium Armoracia	7		*							Fl	My				
Nasturtium lacustre	8									Fl	My				
Nasturtium obtusum	9									Fl	My	Je			
Nasturtium officinale	10									Fl	Ap	N			
Nasturtium palustre	11									Fl	My	Jl			
Nasturtium sessiliflorum	12									Fl	My				
Nasturtium sinuatum	13									Fl	My	Jl			
Raphanus sativus	14		×							Fl	Je	S			
Sisymbrium altissimum	15									Fl	Ap	My			
Sisymbrium canescens	16									Fl	Ap	Je	|		
Sisymbrium officinale	17	±			±					Fl	My	Ag	±		
Polanisia graveolens	18									Fl	Je	Jl			
Helianthemum canadense	19									Fl	My	Je	+		
Lechea major	20									Fl	Je	Jl	*‡		
Lechea minor	21								*‡		Fl	Jl			
Solea concolor	22							|†		Fl	Ap	&	S		
Viola palmata	23						±†	±†	Fl	Ap	My	&	Jl	±†	±†
Viola palmata cucullata	24						±†	±†	Fl	Ap	My	&	Jl	±†	±†
Viola pedata	25								|†	Fl	Ap	My	&	S	
Viola pedata bicolor	26								|†	Fl	Ap	My	&	S	
Viola pedatifida	27									Fl	Ap	My			
Viola pubescens	28									Fl	Ap	My			
Viola Rafinesquii	29	|								Fl	Mr	Ap	|		
Viola striata	30									Fl	Ap	My			
Arenaria patula	31									|	Fl	My			
Cerastium arvense	32	+		+		+				Fl	My	Je			
Cerastium arvense oblongifolium	33	+								Fl	My	Je			
Cerastium nutans	34	±								Fl	Ap	S			±
Cerastium viscosum	35	±								Fl	Ap	S	±		±
Cerastium vulgatum	36	|								Fl	Ap	My			
Lychnis Githago	37	+								Fl	My	Je			
Saponaria officinalis	38	±	±		±					Fl	Je	S			
Silene antirrhina	39	+			+					+	Fl	My	Je		
Silene stellata	40									Fl	My	Ag			
Stellaria longifolia	41									Fl	My	Je			
Stellaria media	42	*	*		*					Fl	Mr	N			
Claytonia virginica	43	|					|	|		Fl	Mr	Ap		|	|
Portulaca oleracea	44	×	×							Fl	Jl	S			
Talinum teretifolium	45									Fl	My				
Bergia texana	46														
Ascyrum Crux-Andreae	47									×	Fl	Je	S		
Hypericum Ascyron	48									Fl	Je	Ag			
Hypericum cistifolium	49								×	Fl	Je	Ag			
Hypericum Drummondii	50									Fl	×	Je	Ag		
Hypericum maculatum	51									Fl	Jl	Ag	×		
Hypericum mutilum	52									Fl	Jl	S			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1				Fr	My	|			|						
												2			Fr	Ap	My	|							|		
|												3				Fr	My						|				
+												4				Fr	Je	Jl									
												5				Fr	My	O		±	±						
		±										6				Fr	My	O								±	
												7															
												8				Fr	Je		|								
								+	+	+	9	+				Fr	Je			+							
												10	±			Fr	My	N									
									+	+	11	+	+	+		+	+	Fr	+	Je	Jl						
												12		|		Fr	Je										
												13			Fr	Je	Ag	+			+						
												14				Fr	Jl	O									
												15				Fr	My	Je		|							
		|		|								16			Fr	My	Je	|		|	|						
				±	±							17			Fr	Jl	S	±		±	±				±		
—				—	—							18				Fr	Jl	Ag		—	—						
												19				Fr	Jl	Ag							+	+	
*‡												20				Fr	Jl	S							*‡		
*‡												21				Fr	Ag	S							*‡	*‡	
		|†										22				Fr	Je	&	O								
N	±†	±†		±†	±†		±†					23			±†	Fr	Je	±†	N	±†	±†	±†		±†		±†	±†
N	±†	±†		±†	±†		±†					24			±†	Fr	Je	±†	N	±†	±†	±†		±†		±†	±†
												25			Fr	My	Je	&	O							|†	
												26			Fr	My	Je	&	O							|†	
												27				Fr	My	Je							|		
								|				28				Fr	|	Ag				|		|			
		|		|	|							29				Fr	Ap	My		|						|	
												30				Fr	|	Je	Jl			|					
												31				Fr	Je										
					+							32				Fr	Je	+	Jl		+						
												33				Fr	Je	+	Jl								
								±				34		Fr	Je	O	±	±						±			
				±	±							35		Fr	Je	O	±	±		±	±						
												36				Fr	My	Je									
				+								37				Fr	Jl			+							
												38				Fr	Ag	O									
+												39				Fr	Jl	Ag					+		+		
	±											40				Fr	Ag	S				±		±			
								|				41		Fr	Jl	|	|		|								
				*	*							42				Fr	My	D		*	*						
		|										43			|		Fr	Je						|		|	|
				×								44				Fr	Ag	O		×							
												45				Fr	Je						|				
												46								—							
												47				Fr	Ag	O									
												48				Fr	S					×			×		
												49				Fr	S	×									
												50				Fr	S -							×			
×	×		×		×							51				Fr	S	×		×	×			×		×	
	×		×					×				52				Fr	×	S	O			×					

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hypericum nudicaule	1									×	Fl	Jl	S		
Hypericum perforatum	2	×			×	×				Fl	Je	O			
Hypericum prolificum	3									Fl	Jl	S			
Abutilon Avicennae	4	×	×		×					Fl	Je	S	×		
Hibiscus lasiocarpus	5									Fl	Ag				
Hibiscus militaris	6									Fl	Ag				
Hibiscus Trionum	7									Fl	Ag				
Malva rotundifolia	8	×	×		×					Fl	My	N			
Sida spinosa	9	×		×						Fl	Je	Ag			
Tilia americana	10									Fl	My	Je			
Linum sulcatum	11									Fl	My	Je			
Linum usitatissimum	12		×		×					Fl	Je	S			
Linum virginianum	13									Fl	Jl	Ag			
Tribulus grandiflorus	14									Fl	Jl	Ag			
Geranium carolinianum	15	±	±		±	±		±		Fl	My	Je	±	±	±
Geranium maculatum	16						+	+		Fl	Ap	Je	+	+	+
Impatiens fulva	17						×			Fl	Jl	S			
Impatiens pallida	18						×			Fl	Jl	S			
Oxalis cymosa	19							±		Fl	Je	O		±	±
Oxalis stricta	20	±	±	±	±	±	±	±	±	Fl	Mr	N	±	±	±
Oxalis violacea	21						Fl	+†	+†	Ap	+†	My	&	S	+†
Ptelea trifoliata	22						*	*		Fl	My				
Ailanthus glandulosus	23		*							Fl	My				
Ilex decidua	24									Fl	My				
Celastrus scandens	25							*		Fl	My			*	
Euonymus atropurpureus	26							*		Fl	*	My	Je	*	
Ceanothus americanus	27							*		Fl	Je	Jl			*
Rhamnus caroliniana	28								*	Fl	Je				
Rhamnus lanceolata	29						*	*	Fl	*	Ap	My	*	*	
Ampelopsis quinquefolia	30						*	*		Fl	Jl				*
Cissus Ampelopsis	31						*			Fl	My				
Cissus stans	32									Fl	My				
Vitis aestivalis	33								*	Fl	My				
Vitis cinerea	34						*			Fl	My				
Vitis cordifolia	35						*		Fl	My	*	*			
Vitis palmata	36									Fl	My				
Vitis riparia	37						*	*		Fl	My	*		*	
Vitis riparia praecox	38									Fl	My				
Acer dasycarpum	39									Fl	Mr	Ap			
Acer rubrum	40									Fl	Mr	Ap			
Acer saccharinum	41						*	*		Fl	*	Ap	My		*
Aesculus glabra	42									Fl	Ap				
Cardiospermum Halicacabum	43									Fl	Jl	Ag			
Negundo aceroides	44									Fl	Ap				
Staphylea trifolia	45						*			Fl	Ap	*	My		
Rhus canadensis	46							*	*	Fl	Mr	Ap		*	*
Rhus copallina	47								*	Fl	Jl		*		*
Rhus glabra	48				*			*	*	Fl	My	Je	*	*	*
Rhus Toxicodendron	49				*		*	*		Fl	My	*		*	*
Polygala verticillata	50									+	Fl	My	+		
Amorpha canescens	51								±	Fl	Je	Jl			
Amorpha fruticosa	52						±			Fl	Ap	My			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1				Fr	S	×	O								
				×								2				Fr	×	S	N								
					×							3				Fr	S	O									
				×			×					4				Fr	×	×	Jl	N						×	
								×				5		×		×	×	Fr	×	S							
												6				×	×	Fr	×	S							×
												7				Fr	S			×							
				×								8				Fr	Je	N		×							
					×							9				Fr	Jl	×	S						×		
		*										10				Fr	Jl		*					*			*
+												11				Fr	Je	Jl					+		+		
					×						12	×				Fr	Jl	O		×							
×												13				Fr	Ag	S							×		
				×								14				×	Fr	Ag	S	×							
	±	±		±	±		±		±		15	±				Fr	Je	±	Ag			±		±	±	±	
	+	+		+	+							16				+	Fr	+	+	Je	Ag	+		+			+
	×	×										17			×	Fr	×	Ag	S			×					×
		×										18				Fr	Ag	S				×					
												19				Fr	Jl	O				±	±	±			
	±	±	±	±	±		±	±				20		Fr	±	±	±	±	±	±	Ap	±	N	±	±	±	±
		+†										21			Fr	My	Je	&	O					+†		+†	
*												22				Fr	S	D					*				*
												23				Fr	Ag	D									
	*											24		*		*	Fr	Je	*	D							
	*											25				Fr	Ag	N				*		*			
												26				Fr	S	*	*					*			
	*	*										27				Fr	S	D					*		*	*	
	*	*										28				Fr	Ag	S				*		*			
												29				Fr	Je	Jl						*			*
*		*										30			*	Fr	S	O					*	*			*
								*				31			*	Fr	S					*					*
								*				32				Fr	S										
		*										33				Fr	Jl	Ag						*	*		
							*	*				34			*	*	*	*	*	Fr	O						*
		*						*				35			*	*	*	*	*	Fr	S	O		*			*
								*				36				Fr	S										
*		*					*	*				37			*	*	*	*	Fr	Ag	S			*			*
												38			*	Fr	Ag	S									
						*	*	*				39		Fr	*	*	*	*	*	Ap	My	*					*
												40				Fr	Ap	My						*			*
		*										41				Fl	Je	Jl				*	*	*			*
	*						*					42				Fr	S	O	*								*
											×	43				Fr	×	S	O								
	*											44				Fr	Ag	S				*		*			*
	*											45				Fr	Jl	Ag				*					*
*	*	*										46				Fr	My	Je				*	*	*			
*												47				Fr	S	O				*	*	*	*	*	
*	*			*								48				Fr	Ag	*	D			*	*	*	*	*	
*	*			*			*	*				49		Fr	*	*	*	*	Jl	*	D	*	*	*	*	*	*
+		+										50				Fr	Jl								+	+	
												51				Fr	Ag	S							±	±	
	±	±								±		52				±	±	Fr	Ag	S		±					±

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Amphicarpaea monoica	1							×	×	Fl	Jl	Ag		×	×
Amphicarpaea Pitcheri	2							×	×	Fl	Jl	Ag		×	×
Apios tuberosa	3						×			Fl	Ag				
Astragalus canadensis	4									Fl	Jl				
Astragalus mexicanus	5								Fl	±	Mr	Ap	±		
Baptisia leucantha	6									Fl	Jl	Ag			
Baptisia leucophaea	7							+	+	Fl	Ap	My			
Cassia Chamaecrista	8	×			×					Fl	Jl	S	×	×	
Cassia marilandica	9									Fl	Ag	×	S		×
Cassia nictitans	10									Fl	Jl	S			
Cercis canadensis	11							*		Fl	Mr	Ap		*	*
Crotalaria sagittalis	12									—	Fl	Je	Jl		
Dalea alopecuroides	13									Fl	Ag	S			
Desmanthus brachylobus	14									Fl	Jl	Ag			
Desmodium acuminatum	15							×		Fl	Jl	Ag			
Desmodium canadense	16	×			×					Fl	Je	Jl			
Desmodium canescens	17	×			×					Fl	Ag		×		
Desmodium ciliare	18									Fl	Jl	Ag			
Desmodium cuspidatum	19						×	×		Fl	Ag	S		×	×
Desmodium Dillenii	20								×	Fl	×	Ag	×	S	
Desmodium marylandicum	21							×		Fl	Jl	Ag			×
Desmodium nudiflorum	22							×		Fl	Jl	Ag			
Desmodium paniculatum	23									Fl	Jl	Ag			
Desmodium rigidum	24									Fl	Jl	Ag			
Desmodium rotundifolium	25								×	Fl	Jl	Ag			×
Desmodium sessilifolium	26									Fl	Jl	Ag			
Gleditschia aquatica	27									Fl	My	Je			
Gleditschia triacanthos	28						*	*		Fl	Ap	My			
Glycyrrhiza lepidota	29									Fl	Jl				
Gymnocladus canadensis	30									Fl	Ap	My			
Lathyrus palustris myrtifolius	31									Fl	My	Je			
Lespedeza capitata	32	×								×	Fl	Jl	×	Ag	
Lespedeza procumbens	33				×			×	×	Fl	Je	Ag	×		
Lespedeza reticulata	34							×	×	Fl	Jl	Ag			×
Lespedeza violacea	35								×	Fl	Ag	S			×
Medicago lupulina	36	×								Fl	Je	S			
Medicago sativa	37	±	±		±					Fl	My	S			
Melilotus alba	38	±	±		±					Fl	Je	Ag	±		
Melilotus officinalis	39	+	+		+					Fl	My	Je			
Petalostemon candidus	40									×	Fl	Je	Ag		
Petalostemon villosus	41									Fl	Je	Ag			
Petalostemon violaceus	42									×	Fl	Je	Ag		
Psoralea Onobrychis	43									Fl	Je	Ag		×	
Psoralea tenuiflora	44								×	Fl	Je	Ag	×		
Robinia Pseudacacia	45	*	*		*				*	Fl	My				
Strophostyles angulosa	46							×		Fl	Jl	N	×	×	
Strophostyles pauciflora	47	×								Fl	Ag	N			
Stylosanthes elatior	48									Fl	Ap	My	|		
Tephrosia virginica	49								×	Fl	Je	Jl			
Trifolium hybridum	50	—	—		—					Fl	My	Ag			
Trifolium pratense	51	±	±	±	±					Fl	My	O			
Trifolium procumbens	52							—		Fl	My	Jl			—

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
	×	×										1			Fr	S	O	×	×			×		×			
	×	×										2			Fr	S	O	×	×			×		×			
					×							3				×					×						×
	—											4				—	Fr	—	—	Ag		—					—
±												5				Fr	Je	±	S						±		±
								×				6				Fr	×	Ag	S								
					+							7				Fr	Je	S							+		
	×			×	×							8			Fr	S	×	×	O	×	×	×			×	×	
	×											9				Fr	S	D	×			×					×
		×										10				Fr	S	O						×	×		
		*										11			*	Fr	Ag	S	*					*		*	*
—				—	—							12				Fr	Ag	—	S	—							
				×								13				Fr	S	O		×							
	×				×							14				Fr	Ag	O	×		×	×					×
		×										15				Fr	S	O						×			
					×							16				Fr	Ag	S		×				×	×		
												17				Fr	S	×		×				×			
												18				Fr	S	×	O								
		×									19	×				Fr	S	×	O				×	×			×
					×					×	20	×				Fr	S	×	O					×	×		
×	×	×										21				Fr	S	O				×	×	×			
		×										22				Fr	S	O					×	×			
×										×	23	×				Fr	S	×	O					×	×		
												24				Fr	S	×	O							×	
		×										25				Fr	S	O						×		×	
												26				Fr	S	O					×			×	
												27	*	*		*	Fr	Ag	*	S							
				*			*	*				28	Fr	S	*	*	*	*	*	*	O						*
												29			Fr	Ag	S	×		×							
							*	*				30	*		*	Fr	S	D									*
	—											31				Fr	Jl	Ag									
							×	×				32		Fr	S	O	×	×							×		
					×		×					33			Fr	Jl	O	×						×	×		
							×					34				Fr	S	N						×	×		
					×		×					35			Fr	S	N	×						×	×		
				×	×							36				Fr	Jl	O		×							
				±								37		Fr	Je	±	±	±	O	±	±						
				±	±		±					38			Fr	Jl	S	±		±	±				±		
					+							39			Fr	Jl	Ag	+		+					+		
×												40				Fr	Jl	O					×		×		
												41				Fr	Jl	O		×							
×												42				Fr	Jl	O					×		×		
	×	×										43				Fr	×	×	Jl	S							
×												44				Fr	Jl	S					×		×	×	
							*	*				45				Fr	*	*	Jl	Ag							
	×				×							46				×	Fr	×	S	D		×			×	×	
												47			Fr	S	D	×					×		×		
|												48				Fr	My	Je					|		|		
												49				Fr	Ag	S							×		
				—	—						50	—				Fr	Je	Ag		—				—			
	±			±	±		±					51			Fr	Je	N	±				±			±		
												52				Fr	Je	Ag									

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Trifolium reflexum	1									Fl	My	Jl			
Trifolium repens	2	±	±	±	±					Fl	Ap	N	±		±
Trifolium stoloniferum	3									Fl	Je	Ag			
Agrimonia Eupatoria	4							±	Fl	My	Jl	±		±	±
Agrimonia parviflora	5							±	Fl	Je	Jl	±		±	±
Amelanchier canadensis	6									Fl	Ap	My			
Crataegus acutifolia	7									Fl	My				
Crataegus atrorubens	8									Fl	My				
Crataegus declivitatis	9									Fl	Ap				
Crataegus Engelmanni	10									Fl	*	My			
Crataegus erecta	11									Fl	My				
Crataegus fecunda	12									Fl	My				
Crataegus insignis	13									Fl	My				
Crataegus Kelloggii	14									Fl	Ap				
Crataegus lanceolata	15									Fl	My				
Crataegus lanigera	16									Fl	Ap				
Crataegus larga	17									Fl	My				
Crataegus ludoviciensis	18									Fl	My				
Crataegus macrophylla	19									Fl	Ap				
Crataegus mitis	20									Fl	My				
Crataegus nitida	21									Fl	My				
Crataegus ovata	22									Fl	My				
Crataegus patrum	23									Fl	My				
Crataegus rubicundula	24									Fl	My				
Crataegus umbrosa	25									Fl	Ap				
Crataegus viridis	26									Fl	My				
Fragaria virginiana	27							±		Fl	Ap	My			±
Geum album	28							±		Fl	My	Jl		±	±
Geum vernum	29									Fl	Ap	My			
Gillenia stipulacea	30								±	Fl	My	Jl			
Physocarpus opulifolius	31						*			Fl	My				
Potentilla canadensis	32	±	±	±	±			±	±	Fl	Ap	Ag	±	±	±
Potentilla norvegica	33			×						Fl	Je	Jl			
Potentilla rivalis millegrana	34									Fl	Je	Jl			
Potentilla supina	35									Fl	Je	Jl			
Prunus americana	36						*	*		Fl	Ap			*	
Prunus Persica	37		*							Fl	Ap		*	*	
Prunus serotina	38						*	*	*	Fl	My			*	*
Prunus virginiana	39									Fl	Ap				
Pyrus coronaria	40							*			*	Fl	My	*	*
Rosa arkansana	41										Fl	My		*	
Rosa blanda	42							*	*	*	Fl	My	Je	*	
Rosa humilis	43							*	*	*	Fl	My	S	*	
Rosa setigera	44						*			Fl	Je	S			
Rubus canadensis	45				*					Fl	Ap	My		*	
Rubus occidentalis	46									Fl	My	Je		*	
Rubus villosus	47					*		*		Fl	My	Je		*	
Spiraea Aruncus	48										±	Fl	My		±
Heuchera americana	49							±		Fl	Ap	My			±
Heuchera hispida	50									Fl	My	Je			
Hydrangea arborescens	51						*			Fl	My	Je			
Ribes gracile	52										*	Fl	My	*	*

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
												1				Fr	Je	Ag				×					
	±			±	±		±					2			Fr	My	N	±		±					±		
		×										3		×		×	Fr	Jl	S								
	±											4				Fr	Je	S				±		±			
	±											5				Fr	Ag	S				±		±			
*							*					6				Fr	Je	Jl					*				*
												7				*	*	Fr	S								
												8					*	Fr	O								
*												9				Fr	O										
												10				Fr	N										
							*	*				11			Fr	S	*	*									
												12			Fr	O	*										
												13			Fr	N	*										
								*				14				Fr	S										
								*				15				Fr	O	N									
												16				Fr	*	Ag									
												17				Fr	*	O									
								*				18				Fr	S	O									
								*				19				Fr	O										
												20			Fr	O	*										
												21			Fr	O	*										
								*				22				Fr	S	O									
								*				23				Fr	O										
								*				24				Fr	O	N									
								*				25				Fr	S										
								*				26				Fr	*	S	O								
				±	±							27				Fr	My	Je		±				±		±	
												28			Fr	Jl	S	±						±			
	±	±										29			Fr	±	±	Jl	±	Ag		±					
±												30				Fr	Je	S					±			±	
		*										31				Fr	Jl	Ag									
	±			±	±		±					32			Fr	My	O	±		±		±		±	±	±	
	×											33				Fr	×	Ag	S			×					
												34			Fr	×	×	Ag	×	S							
							×					35			Fr	Jl	Ag	×					×				
*												36				Fr	Jl	*					*				*
												37				Fr	Ag	S									
	*	*					*			*		38			*	Fr	Ag	*	*			*		*		*	*
												39				Fr	Je	Jl									*
												40			Fr	Jl	S	*						*			*
												41				Fr	Je	Jl						*			
												42				Fr	Je	Jl								*	
*												43				Fr	Je	O					*	*			
	*							*				44		*	Fr	*	*	Ag	*	O		*				*	
				*	*		*					45		Fr	*	*	Je	*	*	*	Jl			*			
	*						*					46			*	Fr	Je	Jl						*			
	*			*	*		*					47				Fr	Jl			*	*	*		*		*	
	±											48				Fr	S						±	±			
±	±				±							49				Fr	Je	Jl				±	±	±			±
+												50				Fr	Jl	Ag					+				
	*	*										51				Fr	Ag					*					*
												52				Fr	Je	Jl						*		*	

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Penthorum sedoides	1								Fl	Jl	Ag	×			
Callitriche deflexa Austini	2						±			Fl	Ap	Je			
Proserpinaca palustris	3									Fl	Jl				
Ammania coccinea	4					×				Fl	Jl	S			
Cuphea viscosissima	5							×		×	Fl	My	Ag		
Decodon verticillatus	6									Fl	Jl				
Lythrum alatum	7					×				Fl	Je	S			
Rotala ramosior	8									Fl	Jl	Ag			
Circaea Lutetiana	9						+			Fl	Je	Jl			
Epilobium coloratum	10									Fl	Jl				
Gaura biennis	11									×	Fl	Jl	S		
Gaura parviflora	12									Fl	My	Jl			
Jussieua repens	13								Fl	Je	O	±			
Ludwigia palustris	14									Fl	Jl	S			
Oenothera biennis	15	*‡	*‡		*‡					Fl	My	O	*‡		
Oenothera biennis muricata	16									Fl	Je	S	*‡		
Oenothera fruticosa	17									Fl	Je	S			
Oenothera sinuata	18									Fl	Jl	Ag			
Mentzelia oligosperma	19									Fl	Je	Jl			
Passiflora lutea	20										×	Fl	Jl	×	×
Citrullus vulgaris	21		×		×					Fl	Jl	S			
Citrullus ovifera pyriformis	22		×		×					Fl	Jl	S			
Echinocystis lobata	23						×			Fl	Jl	Ag			
Sicyos angulatus	24						×			Fl	Jl	Ag			
Opuntia Rafinesquii	25								Fl	*	Jl	S	*		
Mollugo verticillata	26	±	±		±					Fl	My	N			
Chaerophyllum procumbens	27						|			Fl	Ap	My			
Cicuta maculata	28									Fl	Ap	Je			
Coriandrum sativum	29		×							Fl	My	S			
Cryptotaenia canadensis	30									Fl	Ap	Jl			
Daucus Carota	31	±								Fl	Jl				±
Discopleura Nuttallii	32									Fl	Je	Jl			
Erigenia bulbosa	33						|			Fl	Mr	Ap			
Eryngium yuccaefolium	34								±	Fl	±	My	S		±
Foeniculum officinale	35		±							Fl	Je	Jl			
Osmorrhiza brevistylis	36									Fl	Ap	My			
Osmorrhiza longistylis	37									Fl	Ap	My			
Pimpinella integerrima	38							+	+	+	Fl	My	+		
Polytaenia Nuttallii	39									+	Fl	My			
Sanicula marylandica	40							+		Fl	+	Ap	My		+
Sanicula marylandica canadensis	41						+	+		Fl	+	Ap	My		+
Sium cicutaefolium	42									Fl	Jl	Ag			
Thaspium aureum	43							±		±	Fl	Ap	My		±
Thaspium aureum trifoliatum	44									Fl	Ap	My			±
Tiedemannia rigida	45									Fl	Jl	Ag			±
Zizia aurea	46							±		±	Fl	Ap	Je		
Aralia quinquefolia	47							+		Fl	My	Je			
Aralia racemosa	48									Fl	Je	Jl			
Cornus asperifolia	49				*					Fl	Je			*	*
Cornus florida	50									Fl	Ap	My	*		*
Cornus paniculata	51									Fl	My				
Cornus sericea	52									Fl	My				

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1	×			×	Fr	S									
	±											2				Fr	My	S				±					
												3				×	Fr	S	×								
												4		×		Fr	×	S	O								
												5				Fr	Jl	O								×	
												6				×	Fr	S	×	O							
			×									7		×		Fr	×	Ag	O								
											×	8	×			Fr	S										
	+	+										9				Fr	Jl	Ag				+		+			
												10				Fr	S					×					
												11				Fr	Ag	O					×				
												12				Fr	Je	S						+			
						±						13	±	±	Fr	±	Jl	N	±								
											×	14		×	Fr	×	Ag	O	×								
				*‡	*‡						15	*‡		Fr	Jl	D	*‡	*‡		*‡	*‡				*‡	*‡	
				*‡								16			Fr	Jl	O	*‡		*‡							
												17			Fr	Jl	O	×							×	×	
												18			Fr	S	O	×		×	×						
												19				Fr	Jl	Ag					+				
	×	×										20				Fr	Ag	S				×		×			
												21				Fr	Ag	S									
												22				Fr	×	S	O								
								×				23				×	×	Fr	Ag	S							×
								×				24				×	×	Fr	S	O							×
												25				Fr	Jl	*	D						*		
				±								26				Fr	My	N		±	±						
	|	|					|	|				27			|	Fr	|	|	My	Je		|					
								±				28			Fr	±	±	Jl	Ag								
												29				Fr	Je	O									
					±							30			Fr	Ag	±	±	±	O				±			
				±					±			31				Fr	Ag	S		±							
	±							±				32		±		Fr	Ag	S									
	|											33				Fr	My	Je				|					
±				±								34				Fr	Jl	N					±				
												35				Fr	Jl	S									
	+											36				Fr	My	Je				+		+			
												37				Fr	Je	Jl				+		+			
+	+				+							38				Fr	Jl					+	+	+	+		
												39				Fr	Jl	Ag					+		+		
	+	+										40				Fr	Jl	Ag				+		+		+	
	+	+										41				Fr	Jl	Ag				+		+		+	+
												42	±	±	Fr	±	±	S	±	O							
												43				Fr	Ag	S					±				
	±											44				Fr	Ag	S				±		±			±
												45				Fr	Ag	S									
												46				Fr	Jl	S									
		+										47				Fr	Jl	Ag				+					+
±		±										48				Fr	Ag	S					±				
		*										49			Fr	*	Jl	*	*	Ag				*			*
		*										50				Fr	S							*			
												51				Fr	Jl	Ag									*
												52			Fr	*	Jl	Ag	*								

DISTRIBUTION AND PHENOLOGY		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sambucus canadensis	1						*	*		Fl	*	Je	Jl	*	*
Symphoricarpus vulgaris	2				*‡			*‡	*‡	Fl	Jl	Ag	*‡	*‡	
Triosteum angustifolium	3								±	Fl	My		±		±
Triosteum perfoliatum	4								±	Fl	My	Je	±	±	±
Viburnum Lentago	5						*			Fl	Ap	My			
Viburnum prunifolium	6							*	*	Fl	Ap	My	*		*
Viburnum rufotomentosum	7									Fl	My				
Cephalanthus occidentalis	8								Fl	Je	Jl	*‡			
Diodia teres	9									Fl	Je	Jl	×		
Galium Aparine	10									Fl	Ap	My		+	
Galium asprellum	11									Fl	My	Je			
Galium circaezans	12							±		Fl	Je	Jl			
Galium concinnum	13									Fl	Je	Jl		±	
Galium pilosum	14							×		Fl	Jl	S			
Galium triflorum	15									Fl	Je	Jl			
Houstonia angustifolia	16								Fl	±	Ap	Ag			
Houstonia minima	17			|						Fl	Mr	My	|		|
Houstonia purpurea	18									±	Fl	Ap	S		±
Houstonia purpurea longifolia	19										Fl	Ap	S		±
Spermacoce glabra	20					±			Fl	My	S	±			
Valerianella radiata	21									Fl	Ap	My			
Dipsacus sylvestris	22				*					Fl	Je	Jl			
Achillea Millefolium	23	*	*	*	*					Fl	My	S	*		*
Actinomeris squarrosa	24						×	×		Fl	Jl	S	×		×
Ambrosia artemisiaefolia	25	×		×		×				Fl	Ag				
Ambrosia bidentata	26									Fl	S				
Ambrosia psilostachya	27									Fl	Jl	Ag			
Ambrosia trifida	28	×	×							Fl	Ag	S			
Antennaria plantaginifolia	29				±				±	Fl	Mr	My	±		±
Anthemis Cotula	30	×	×		×					Fl	Je	Ag			
Arctium Lappa minus	31	*	*	*	*					Fl	Jl	S			
Artemisia biennis	32									Fl	Ag	S			
Artemisia Ludoviciana	33									Fl	S	O			
Aster azureus	34							=		Fl	S				=
Aster cordifolius	35							=		Fl	S				=
Aster diffusus	36									Fl	S				
Aster Drummondii	37									Fl	S				
Aster ericoides	38	=			=					Fl	S				
Aster laevis	39									=	Fl	S			
Aster linariifolius	40								=	Fl	S				
Aster multiflorus	41	=			=					Fl	S				
Aster novae-angliae	42						=			Fl	S		=		
Aster oblongifolius	43									=	Fl	S			
Aster oblongifolius rigidulus	44									Fl	S				
Aster patens	45							=	=	Fl	S		=		
Aster sagittifolius	46									Fl	S		=		
Aster salicifolius	47									Fl	S	=			
Aster turbinellus	48							=	=	Fl	S				=
Bidens Beckii	49									Fl	Ag				
Bidens bipinnata	50									Fl	Ag	S			
Bidens cernua	51									Fl	Ag	S			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
	*	*		*	*					*		1			Fr	Ag	S	*	*	*		*		*			*
*‡		*‡										2			Fr	S	D	*‡						*‡	*‡	*‡	*‡
												3				Fr	Jl	Ag	±					±	±		
												4				Fr	S	O	±					±	±	±	
												5				Fr	S	O									*
*		*										6				Fr	S	N						*			
*		*										7				Fr	S	N					*				
						*‡						8	*‡	*‡	Fr	*‡	S	D	*‡								
				×								9				Fr	S	O									
	+	+										10				Fr	Je	Jl					+	+			
												11				Fr	Jl	Ag						+			
		±										12				Fr	Ag	S						±			
		±										13				Fr	Ag	S						±			
		×										14				Fr	Ag	O									
							±					15			Fr	Ag	S	±									
±												16				Fr	Je	S					±		±		
												17				Fr	Ap	|	My						|		
±												18				Fr	Je	±	S					±			
												19				Fr	Je	S									
						±		±				20				±	±	Fr	±	Je	O						
								|				21			Fr	My	Je	|	|			|					
												22				Fr	Ag	S									
					*							23			Fr	Jl	N	*						*	*	*	
×							×					24			Fr	S	O	×					×		×		×
				×								25	Fr	S	O	×	×	×	×	×	×				×		
												26			Fr	S	O	×							×		
												27				Fr	S			×					×		
				×				×		×	×	28		Fr	O	×	×	×		×					×		
					±							29				Fr	Ap	My			±		±		±	±	
												30				Fr	Jl	O			×					×	
				*								31			Fr	Ag	N	*		*					*	*	
							×					32				Fr	S	O									
									=		33	=				Fr	O	N									
		=										34				Fr	O							=			
=		=										35				Fr	O						=	=			
								=				36				=	=	Fr	O								
	=											37				Fr	O									=	
					=							38				Fr	O			=					=	=	
												39				Fr	O						=		=		
												40				Fr	O								=		
				=	=							41				Fr	O						=		=		
=												42				Fr	O						=		=		=
=												43				Fr	O						=				
												44				Fr	O						=				
												45				Fr	O	=		=					=	=	
												46				Fr	O						=				
						=		=				47		=		=	Fr	O									
		=										48				Fr	O							=	=		
												49		×		×	Fr	S	O								
×				×			×					50				Fr	S	×	O				×			×	
								×			×	51				Fr	S	O	×								

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bidens chrysanthemoides	1									Fl	Ag	S			
Bidens connata	2									Fl	S				
Bidens frondosa	3									Fl	S				
Boltonia asteroides	4									Fl	Ag	S			
Boltonia asteroides decurrens	5									Fl	Ag	S			
Cacalia atriplicifolia	6							±		Fl	Jl	Ag			±
Cacalia reniformis	7							±		Fl	Jl	Ag			
Cacalia tuberosa	8									±	Fl	My	Jl		
Chrysanthemum Leucanthemum	9		±		±					Fl	My	Jl			
Chrysopsis villosa	10				±				±	Fl	Jl				
Cichorium Intybus	11		×			×				Fl	Jl	Ag			
Cnicus altissimus	12			±	±			±		Fl	Jl	Ag		±	±
Cnicus arvensis	13	±		±						Fl	Jl	Ag	±		
Cnicus pumilus	14	±		±						Fl	Jl	S	±		
Coreopsis aristosa	15	×	×						Fl	Ag	O	×			
Coreopsis aristosa mutica	16	×	×		×				Fl	Ag	O	×			
Coreopsis palmata	17									Fl	Je	Jl			
Coreopsis tinctoria	18		×							Fl	Je	Jl			
Coreopsis tripteris	19						×			Fl	Jl	Ag			
Dysodia chrysanthemoides	20									Fl	Ag	S			
Echinacea angustifolia	21									×	Fl	Jl	Ag		
Echinacea purpurea	22									Fl	Jl	Ag		×	×
Eclipta alba	23					±			Fl	Jl	S	±			
Elephantopus carolinianus	24							×	×	Fl	Jl	S			×
Erechtites hieracifolia	25							×		Fl	Ag	S			×
Erigeron annuus	26	|	|	|	|			|		Fl	Ap	My		|	|
Erigeron bellidifolius	27								*	Fl	Ap	My			*
Erigeron canadensis	28	±		±	±				±	Fl	Jl	S	±		±
Erigeron philadelphicus	29	±	±		±					Fl	My	S	±		
Erigeron strigosus	30	±		±	±					Fl	Je	S			
Eupatorium ageratoides	31							×		Fl	Ag	S		×	×
Eupatorium altissimum	32							×		×	Fl	Ag	S		
Eupatorium coelestinum	33							×		Fl	Ag	S			
Eupatorium perfoliatum	34									Fl	Ag	S			
Eupatorium purpureum	35						×			Fl	Jl	Ag			
Eupatorium serotinum	36	×	×	×	×			×	Fl	Ag	×	S	×		
Gnaphalium polycephalum	37	±		±					±	Fl	Ap	My			
Helenium autumnale	38									Fl	Ag	S			
Helenium nudiflorum	39						×		Fl	Ag	S	×			
Helianthus annuus	40	×	×		×					Fl	Jl	S			
Helianthus doronicoides	41									Fl	Jl	S			
Helianthus grosse-serratus	42									Fl	Ag	S	×		
Helianthus hirsutus	43									Fl	Jl	Ag			
Helianthus laetiflorus	44								×	×	Fl	Ag	×		
Helianthus mollis	45									Fl	Jl	O	×		
Helianthus occidentalis	46								×	Fl	Ag			×	×
Helianthus rigidus	47									Fl	Ag				
Helianthus tuberosus	48	×	×		×					Fl	Ag	S			
Heliopsis laevis	49									Fl	Jl	S	×		×
Heliopsis scabra	50									Fl	Ag	S	×		
Iva ciliata	51								Fl	Ag	S	×			
Krigia amplexicaulis	52							+		Fl	Ap	Je	+		+

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
											×	1				×	Fr	O	×	N							×
										2	×	×		×		×	Fr	O	×			×		×			
												3				×	Fr	O									
												4				×	×	Fr	×	S	O	×					
												5					×	Fr	S	O							
	±	±										6				Fr	S	O				±		±			
	±	±										7				Fr	S	O				±		±			
												8				Fr	S	O									
				±	±							9				Fr	Jl	Ag		±	±						
					±							10				Fr	Ag	±	S						±		
												11				Fr	S			×	×						
				±	±							12				Fr	Ag	S	±					±			
												13				Fr	Ag	S									
												14				Fr	Ag	N							±		
						×		×				15		×		×	×	Fr	×	S	N						
						×		×	×			16		×		×	×	Fr	×	S	N						
×												17				Fr	Ag	S					×		×		
												18				Fr	Ag	S		×							
				×	×							19				Fr	S			×	×			×			
												20				Fr	S	×	O						×		
												21				Fr	Ag	S						×		×	
												22				Fr	Ag	S						×			
			±			±						23			±	±	±	Fr	±	S	O						±
		×										24				Fr	S	×	O					×	×		
		×										25				Fr	S	O						×			
	|	|		|			|					26				Fr	|	|	My	Je		|		|	|		|
												27				Fr	My	Je						*	*		
				±	±		±					28				Fr	±	±	S	±	O			±	±	±	
	±	±		±								29				Fr	Je	±	N	±				±	±		
				±	±		±					30				Fr	Ag	±	N						±		
	×											31				Fr	S	O				×		×			
		×										32				Fr	S	O						×		×	
	×	×										33				Fr	S	O				×		×			
	×	×										34				Fr	S	O	×			×					
	×	×					×	×				35			×	×	×	×	×	Fr	S	×		×		×	×
	×	×			×		×	×				36		Fr	×	×	×	×	×	S	O	×		×	×	×	×
												37				Fr	Je	Jl						±	±	±	
	×						×					38					×	Fr	O								
						×		×				39				×	×	Fr	×	S	O						
				×								40				Fr	×	×	Ag	×	O						
												41				×	×	Fr	Ag	O							
	×			×								42				Fr	S	O		×		×			×		
	×											43				Fr	Ag	S				×			×		
												44				Fr	S								×		
												45				Fr	S	O							×		
					×							46				Fr	S			×					×		
												47				Fr	×	S							×		
				×			×	×				48				Fr	×	×	S	×	O						
												49			Fr	Ag	O	×						×			
												50				Fr	S	O							×		
						×		×			×	51		×		×	×	Fr	×	S	O						
	×				×							52				Fr	Jl	Ag				+		+		+	

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Kuhnia eupatorioides	1									Fl	Ag	O	×		
Lactuca canadensis	2	×	×	×	×					Fl	Jl	Ag		×	
Lactuca leucophaea integrifolia	3									Fl	Ag	S			
Lactuca ludoviciana	4	×			×			×		Fl	Jl	S		×	×
Lactuca Scariola	5	±	±	±	±			±		Fl	Jl	S	±		
Lactuca Scariola integrata	6	±	±	±	±			±		Fl	Jl	S	±		
Liatris cylindrica	7									Fl	Ag	S			
Liatris pycnostachya	8									Fl	Ag	S			
Liatris scariosa	9									×	Fl	Ag	×	S	
Matricaria Chamomilla	10		+		+					Fl	My	Ag			
Matricaria discoidea	11	+	+	+	+	+				Fl	My	Ag			
Parthenium integrifolium	12									±	Fl	Jl	±	Ag	
Parthenium repens	13									+	Fl	Ap	My		
Pluchea camphorata	14									Fl	Jl	Ag			
Polymnia canadensis	15									Fl	Jl	S			
Polymnia Uvedalia	16									Fl	Ag	S			
Prenanthes alba	17									±	Fl	S			
Prenanthes racemosa	18									Fl	Ag	S			±
Rudbeckia hirta	19	×		×	×			×	×	Fl	Je	Ag			
Rudbeckia laciniata	20						×			Fl	Jl	S			
Rudbeckia triloba	21	×			×	×		×	×	Fl	Ag	S	×		
Senecio aureus	22						±			±	Fl	Ap	My		±
Senecio aureus Balsamitae	23								Fl	Ap	My	±			
Senecio lobatus	24									Fl	My	Je			
Silphium integrifolium	25				±			±		Fl	Jl	Ag	±	±	
Silphium perfoliatum	26	±				±			Fl	Ag	S	±			
Silphium terebinthinaceum	27								Fl	±	±	Ag	±	S	
Solidago canadensis	28	×		×	×					Fl	Ag	S	×		
Solidago Drummondii	29									Fl	Ag	S			
Solidago lanceolata	30									Fl	Ag	S			
Solidago latifolia	31									Fl	Ag	S			
Solidago missouriensis	32									Fl	Ag	S			
Solidago nemoralis	33									Fl	Ag	S	×		
Solidago petiolaris	34									×	Fl	Ag	×	S	
Solidago radula	35							×		Fl	Jl	S			×
Solidago rigida	36								×	×	Fl	Ag	S		×
Solidago serotina	37	×		×	×					Fl	Jl	Ag	×		
Solidago speciosa	38									Fl	S	O	×		×
Solidago ulmifolia	39							×		Fl	Jl	Ag			
Sonchus asper	40	±	±		±					Fl	Ap	Ag			
Sonchus oleraceus	41	±	±		±					Fl	Ap	Ag			
Taraxacum officinale	42	±	±	±	±	±		±	±	Fl	Mr	O	±		
Verbesina encelioides	43									Fl	Jl				
Verbesina helianthoides	44							±	±	Fl	Je	Jl			±
Vernonia altissima	45									Fl	Ag	S			
Vernonia Baldwinii	46	×		×						Fl	Ag	S			
Vernonia fasciculata	47									Fl	Ag	S			
Vernonia noveboracensis	48	±		±	±			±		Fl	Ag	S	±	±	±
Xanthium canadense	49	±			±	±	±			Fl	Je	S			
Xanthium strumarium	50									Fl	Je	S			
Lobelia cardinalis	51									Fl	Ag	O			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
×												1				Fr	S	O					×		×		
					×		×					2			Fr	Ag	S	×						×			
				×								3				Fr	S	O						×			
	×				×		×		=			4			×	Fr	×	Ag	O			×		×			
±	±	±	±	±	±		±	±	±			5				Fr	±	±	Ag	±	O	±			±	±	
±	±	±	±	±	±		±	±	±			6				Fr	±	±	Ag	±	O	±			±	±	
×	×											7				Fr	S	O				×	×				
												8				Fr	S	O							×		
												9				Fr	S	O							×		
		+	+	+	+							10				Fr	Je	S									
				+								11				Fr	Je	S								+	
±												12				Fr	S	O					±		±		
												13				Fr	Je	Jl									
											×	14				Fr	Ag	S									
	×											15				Fr	Ag	O				×					
												16			×	Fr	S							×			
												17				Fr	O							±			
	±											18				Fr	S	O				±		±			
×				×								19				Fr	Ag	S		×				×	×		
	×						×					20			Fr	S	O	×				×					×
			×	×								21			Fr	S	O	×		×				×	×		
								±				22			±	±	±	Fr	±	My	Je						
						±		±				23			Fr	±	±	Je	Jl								
												24		±	Fr	±	±	Jl	Ag								
	±			±	±							25				Fr	S	O		±		±			±		
						±		±				26				±	±	Fr	±	S	O						
												27				Fr	S	O							±		
				×	×							28			Fr	S	O	×		×							
×												29				Fr	S	O					×				
												30		×		Fr	×	×	S	O							
	×	×										31				Fr	S	O				×		×			
												32				Fr	S	O								×	
												33				Fr	S	O							×		
												34				Fr	S	O							×		
												35				Fr	S	O						×		×	
												36				Fr	S	O						×	×		
				×	×							37			Fr	S	O	×		×				×			
												38				Fr	O	N							×	×	
×												39				Fr	S	O					×				
												40			Fr	Jl	S	±								±	
												41			Fr	Jl	S	±								±	
±	±	±	±	±	±		±	±				42			Fr	Mr	±	±	O	±	±	±			±	±	
												43				Fr	Ag	S		×							
±												44				Fr	Ag	S					±			±	
												45				Fr	×	S	O			×		×			
												46				Fr	S	×	O								
								×	×			47	×			×	×	Fr	S	O				×			
		±		±	±		±	±				48				±	±	Fr	S	O				±	±		±
							±					49			Fr	±	±	±	±	Ag	D						
												50				Fr	Ag	D									±
												51		*	*	*	Fr	S	*	N							

DISTRIBUTION AND PHENOLOGY		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lobelia inflata	1			×					×	Fl	Jl	Ag	×		
Lobelia leptostachys	2	×						×	×	Fl	Jl	Ag			
Lobelia syphilitica	3					×			Fl	Ag	O	×			
Campanula americana	4									Fl	Jl	S			
Specularia perfoliata	5	±			±					Fl	My	Je			
Androsace occidentalis	6	|		|	|				|	Fl	Mr	My	|		
Dodecatheon Meadia	7									Fl	|	Ap	My		|
Lysimachia stricta	8									Fl	Jl	Ag			
Samolus Valerandi americana	9					×				Fl	Jl	Ag			
Steironema ciliatum	10									Fl	Jl	Ag			
Steironema lanceolatum	11									Fl	Jl	Ag			
Diospyros virginiana	12							*		*	Fl	My	Je		*
Forestiera acuminata	13									Fl	Ap				
Fraxinus americana	14						*	*		Fl	Ap				*
Fraxinus viridis	15						*			Fl	Ap				
Amsonia Tabernaemontana	16									Fl	Ap	My			
Apocynum androsaemifolium	17								±	Fl	My	Je	±		
Apocynum cannabinum	18					±		±		Fl	Je	Jl		±	±
Acerates viridiflora	19									±	Fl	Je	Jl		
Asclepias Cornuti	20	×			×					Fl	Je	Ag			
Asclepias incarnata	21									Fl	Je	Jl			
Asclepias obtusifolia	22	×			×					Fl	Je	Jl			
Asclepias purpurascens	23							×		Fl	Je	Jl		×	×
Asclepias quadrifolia	24									+	Fl	My	Je		
Asclepias tuberosa	25	×							×	×	Fl	Je	×	Ag	
Asclepias verticillata	26								×	×	Fl	Jl	×	Ag	
Asclepiodora viridis	27									×	Fl	Jl	Ag		
Enslenia albida	28						×	×		Fl	Je	Jl		×	
Gonolobus carolinensis	29							±		±	Fl	My	Je		
Gentiana Andrewsii	30									Fl	S	O			
Sabbatia angularis	31	×							×	×	Fl	Ag	×	S	
Phlox divaricata	32						*‡			Fl	Ap	My		*‡	*‡
Phlox pilosa	33									Fl	My	Je	*‡		
Polemonium reptans	34						+			Fl	Ap	My		+	+
Ellisia Nyctelea	35	+	+		+	+	+			Fl	Ap	My			
Hydrophyllum appendiculatum	36							+		Fl	Ap	My			
Hydrophyllum canadense	37									Fl	Ap	My			
Hydrophyllum virginicum	38									Fl	Ap	My			
Phacelia bipinnatifida	39									Fl	Ap	My			
Phacelia Purshii	40									Fl	Ap	My			
Cynoglossum virginicum	41									Fl	My	Jl		±	±
Echinospermum virginicum	42							×		Fl	Jl				×
Heliotropium indicum	43									Fl	Ag	O			
Heliotropium tenellum	44									×	Fl	Je	Jl		
Lithospermum arvense	45	+		+	+					Fl	Ap	My			
Lithospermum canescens	46									+	Fl	Ap	My		
Lithospermum latifolium	47									Fl	Mr	Je			
Onosmodium carolinianum	48									×	Fl	Jl	Ag		
Convolvulus arvensis	49	×			×					Fl	Je	S			
Convolvulus Sepium	50	×			×		×			Fl	My	S			
Cuscuta arvensis	51									Fl	Jl	Ag			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1			Fr	Ag	S	×						×			
												2				Fr	Ag	S								×	
				×		×		×				3		×	Fr	×	×	S	×	O							
	×			×								4				Fr	S	O	×			×		×			
												5				Fr	Jl	Ag								±	
|												6				Fr	Ap	My					|			|	
												7				Fr	My	Je						|			
												8				Fr	S	O	×								
								×	×		×	9	×			×		Fr	×	Ag	S						
							×	×				10		×	×	×	×	Fr	×	Ag	S						
							×	×				11		×	×	×	×	Fr	×	Ag	S	×					
	*	*										12				Fr	S	N						*		*	
								*				13			*	*	*	Fr	My								*
	*	*					*					14				Fr	Ag	*	D					*		*	*
*								*				15				*	*	Fr	Ag	D							*
												16				±	±	Fr	±	Ag	S						
												17				Fr	Ag	S									
		±		±	±		±					18				±	Fr	±	Ag	S				±	±		±
												19				Fr	Ag	S						±		±	
				×			×					20			Fr	Ag	O	×								×	
								×				21			Fr	×	×	Ag	O								
				×			×					22			Fr	Ag	O	×		×							
	×			×			×					23			Fr	Ag	O	×		×				×		×	
	+											24				Fr	Jl	Ag				+		+		+	
												25				Fr	Ag	O							×	×	
×	×											26				Fr	Ag	O				×	×		×		
												27				Fr	S	O									
							×					28			Fr	Ag	O	×									×
												29				Fr	Ag	S								±	
												30				Fr	O	N						×			
												31				Fr	S	O								×	
	*‡											32				Fr	My	Je				*‡		*‡			*‡
*‡	*‡											33				Fr	Je	Jl				*‡	*‡	*‡	*‡	*‡	
	+	+										34				Fr	My	Je				+		+			+
			+									35			Fr	My	Je	+									
	+	+										36				Fr	Je	Jl				+		+			
	+	+										37				Fr	Je	Jl				+					
	+	+										38				Fr	Je	Jl				+					
												39				Fr	My	Je				+					
												40			Fr	Je	Jl	+	+	+	+	+					
												41			Fr	Ag	S	±						±			
	×											42				Fr	O					×		×		×	
								×				43		×	Fr	×	×	S	O								×
												44				Fr	S										
					+							45				Fr	Je	Jl			+						
+	+											46				Fr	Je	Jl						+		+	
	+			+	+							47				Fr	Ap	Jl		+		+					
												48				Fr	Ag	S						×			
					×							49				Fr	Jl	O	×	×							
							×	×				50				Fr	×	×	Je	O				×			×
								×				51	×			×	×	Fr	S	O							

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cuscuta chlorocarpa	1									Fl	Jl	Ag			
Cuscuta compacta	2									Fl	Jl	Ag			
Cuscuta glomerata	3									Fl	Jl	Ag			
Cuscuta Gronovii	4									Fl	Ag	S			×
Ipomoea hederacea	5	×	×		×					Fl	Je	S			
Ipomoea lacunosa	6									Fl	Jl	S			
Ipomoea pandurata	7						×			Fl	Jl	S			
Ipomoea purpurea	8	×	×		×					Fl	Je	S			
Datura Stramonium	9	×	×		×					Fl	Je	O	×		
Datura Tatula	10	×	×		×					Fl	Je	O	×		
Nicandra physaloides	11		+							Fl	Ap	Jl			
Physalis angulata	12									Fl	Je	Jl	×		
Physalis philadelphica	13									×	×	Fl	Ag	S	×
Physalis pubescens	14									Fl	Je	Ag			
Physalis subglabrata	15									Fl	My	S			±
Solanum carolinense	16	±	±	±	±			±		Fl	Ap	S	±		
Solanum elaeagnifolium	17									Fl	Je	Jl			
Solanum nigrum	18		×		×		×	×		Fl	Je	×	S	×	×
Solanum rostratum	19	+	+	+						Fl	Je	Jl	+		
Conobaea multifida	20	×				×				Fl	My	Jl			
Gerardia aspera	21									Fl	Ag	S			
Gerardia auriculata	22									Fl	S	O			
Gerardia tenuifolia	23								×	×	Fl	Ag	×	O	×
Gerardia tenuifolia asperula	24									Fl	Ag	O			
Gratiola sphaerocarpa	25					×				Fl	Je	Ag			
Gratiola virginiana	26									Fl	Je	Ag			
Herpestis rotundifolia	27									Fl	Jl	O			
Ilysanthes riparia	28					±				Fl	My	Jl			
Linaria vulgaris	29									Fl	Je	S			
Mimulus alatus	30					×				Fl	Jl	S			
Mimulus ringens	31								Fl	Jl	S	×			
Pedicularis canadensis	32						+		+	Fl	Ap	My			+
Pentstemon laevigatus Digitalis	33							×		Fl	Jl	S	×		
Pentstemon pubescens	34							+	+	+	Fl	My	Je		+
Scrophularia nodosa marylandica	35									Fl	My	O		±	
Seymeria macrophylla	36								×	Fl	Jl	S			
Verbascum Blattaria	37	±			±					Fl	Je	Ag	±		
Verbascum Thapsus	38	*	*	*	*				*	Fl	Je	S	*		
Veronica arvensis	39	|		|						|	Fl	Ap	My	|	
Veronica peregrina	40	±	±	±		±			Fl	Ap	My	±			
Veronica virginica	41							±		Fl	Je	S			
Aphyllon uniflorum	42									Fl	Ap	My		|	|
Utricularia biflora	43									Fl	Jl	Ag			
Utricularia vulgaris	44									Fl	Jl	Ag			
Tecoma radicans	45	*			*		*	*		Fl	Je	Ag			
Ruellia ciliosa	46								Fl	±	Je	Ag	±		
Ruellia strepens	47						±			Fl	Je	Ag			
Lippia lanceolata	48					×			Fl	Je	S	×			
Phryma leptostachya	49							×		Fl	Je	Jl		×	×
Verbena angustifolia	50								Fl	±	My	S	±		
Verbena Aubletia	51							Fl	±	±	Ap	S	±		

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
								×				1	×			×	×	Fr	S	O							
								×				2	×			×	×	Fr	S	O							
								×				3	×			×	×	Fr	S	O							
								×				4				×	×	Fr	S	O							
				×	×							5				Fr	×	×	Jl	×	O				×		
												6	×	×		×	×	Fr	×	A	O						
	×				×		×	×				7			×	Fr	×	×	Ag	O		×					×
								×	×			8				Fr	×	×	Ag	O							
				×	×		×		9	×	×	×			Fr	×	×	×	Ag	×	D				×	×	
				×	×		×		10	×	×	×			Fr	×	×	×	Ag	×	D				×	×	
												11				Fr	My	Ag								+	
	×			×							12	×			Fr	S	O	×		×						×	
	×			×	×							13				Fr	Ag	S	×	×	×	×					
												14			Fr	Jl	Ag	×			×						
	±											15				Fr	Je	S						±			
	±	±		±	±		±	±		16	±	±			Fr	Jl	±	±	D	±	±	±			±	±	
												17				Fr	Ag	O		×							
	×	×	18	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	Fr	×	Ag	N	×
				+	+							19				Fr	Jl	O		+	+				+	+	
			×					×	×		×	20	×	×		Fr	×	Ag	S	×							
												21			Fr	S	O	×					×			×	
												22				Fr	O	N						×			
												23				Fr	S	N					×	×		×	
												24				×	×	Fr	×	S	N						
			×								×	25	×	×		×	×	Fr	×	Ag	S						
											×	26	×	×		×	×	Fr	×	Ag	S						
												27				×	Fr	Ag	O								×
			±			±						28	±		Fr	±	Je	Ag	±								
												29				Fr	S	O		×							
			×								×	30		×	Fr	×	×	S	O								
			×			×						31				Fr	S	O	×								
												32				Fr	My	Je						+			
	×	×					×					33		×	Fr	×	×	×	×	S	O						×
	+											34				Fr	Je	Jl						+			
	±				±		±					35			Fr	Je	N	±				±		±		±	
	×	×										36				×	Fr	×	×	S	O	×				×	×
				±								37			Fl	Ag	S	±		±							
*	*			*	*		*	*			38	*			Fr	Ag	O	*		*	*	*	*		*	*	
												39			Fr	My	Je	|							|	|	
			±	±		±					±	40				Fr	±	Je	Jl	±							
	±			±	±			±				41.		Fr	Ag	±	±	O	±	±	±	±		±			
												42				Fr	My	Je						|		
												43			Fr	×	Ag	S	×								
												44			Fr	×	Ag	S	×								
*				*	*		*	*				45			Fr	Ag	*	*	D	*	*	*	*				*
±												46			Fr	Jl	S	±					±			±	
	±	±										47				Fr	Jl	S				±		±			±
			×					×	×		×	48	×	×	Fr	×	×	Jl	×	O							
					×							49				Fr	Ag	S						×			
±												50				Fr	Je	N								±	
±	±											51				Fr	My	N								±	

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Verbena bracteosa	1				×					Fl	Je	S			
Verbena hastata	2	×				×				Fl	Jl	Ag			
Verbena stricta	3	±		±	±					Fl	Je	S	±		
Verbena urticaefolia	4	±		±	±					Fl	Jl	S	±		
Blephilia ciliata	5	+						+	Fl	+	My	Je	+		+
Blephilia hirsuta	6									Fl	Je	Jl			
Brunella vulgaris	7	±	±	±	±	±	±	±	Fl	±	Je	Ag	±	±	±
Cunila Mariana	8								±	Fl	Jl	S	±		
Hedeoma pulegioides	9			×				×	×	Fl	Jl	Ag	×		×
Isanthus caeruleus	10								×	×	Fl	Jl	×	Ag	
Lamium amplexicaule	11		+							Fl	Mr	Jl			
Leonurus Cardiaca	12		±							Fl	My	Jl			
Lophanthus nepetoides	13						×			Fl	Jl	S			
Lycopus sinuatus	14					×				Fl	Jl	S			
Lycopus virginicus	15					×				Fl	Jl	S			
Marrubium vulgare	16		±							Fl	My	Jl			
Melissa officinalis	17		±							Fl	Je	Ag			
Mentha canadensis	18									Fl	Ag	S			
Monarda Bradburiana	19							±	±	Fl	My	Jl			
Monarda fistulosa	20	*‡			*‡		*‡			Fl	Je	S	*‡	*‡	*‡
Monarda punctata	21								×	×	Fl	Je	S		
Nepeta Cataria	22		×							Fl	Je	Ag			
Nepeta Glechoma	23						±			Fl	Ap	S			
Physostegia virginiana	24									Fl	Ag	S			
Pycnanthemum lanceolatum	25							±		Fl	Jl	S		±	±
Pycnanthemum linifolium	26							±		Fl	Jl	S		±	±
Pycnanthemum muticum pilosum	27							±		Fl	Jl	S			±
Scutellaria canescens	28									Fl	Je	Ag			
Scutellaria lateriflora	29									Fl	Jl	Ag			
Scutellaria parvula	30									|	Fl	Ap	My		
Scutellaria versicolor	31						×	×		Fl	Jl	S		×	×
Stachys aspera	32									Fl	Jl	Ag			
Stachys palustris	33					—				Fl	Jl	S			
Teucrium canadense	34									Fl	Je	Ag			
Plantago lanceolata	35	±	±							Fl	My	Ag	±		
Plantago patagonica aristata	36	±	±		±				±	Fl	My	Jl	±		±
Plantago pusilla	37			|						Fl	Ap	My	|		
Plantago Rugelii	38	±	±	±	±	±				Fl	Je	Ag	±		
Oxybaphus nyctagineus	39				×			×		Fl	Je	Ag			
Anychia dichotoma	40					×				Fl	Jl	Ag			
Acnida tuberculata	41									Fl	Ag	S			
Amaranthus albus	42									Fl	Je	Jl			
Amaranthus blitoides	43									Fl	Je	Jl			
Amaranthus paniculatus	44	×								Fl	Jl	Ag			
Amaranthus retroflexus	45	×								Fl	Jl	Ag			
Amaranthus spinosus	46	×	×		×					Fl	Jl	S			
Atriplex patulum hastatum	47	=			=					Fl	S				
Chenopodium album	48	×			×					Fl	Jl	S			
Chenopodium ambrosioides	49	×								Fl	Jl	S			
Chenopodium ambrosioides anthelminticum	50	×								Fl	Jl	S			
Chenopodium hybridum	51	×								Fl	Jl	S			

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
					×							1				Fr	Jl	N			×					×	
	×					×		×				2		×		×	×	Fr	×	S	O	×					
							±					3			Fr	Ag	N	±							±		
				±	±		±					4			Fr	Ag	N	±		±	±				±	±	
+												5				Fr	Jl	Ag					+	+		+	
	×	×					×	×				6				Fr	×	Ag	S					×			
	±	±	±	±			±	±				7	Fr	Jl	O	±	±	±	±	±		±		±	±	±	±
												8				Fr	S	O							±		
												9				Fr	S	O						×	×		
												10				Fr	S	O							×	×	
				+	+							11				Fr	Ap	Jl									
												12				Fr	Ag	S									
								×				13				Fr	×	S	O								×
			×			×						14		×	Fr	×	S	O	×								
			×			×						15		×	Fr	×	S	O	×								
												16				Fr	Jl	S									
												17				Fr	Jl	S									
												18	±	±	Fr	±	±	S	±	O							
±	±											19				Fr	Ag	S						±			
	*‡			*‡	*‡		*‡					20			Fr	Ag	N	*‡		*‡		*‡		*‡	*‡		*‡
×												21				Fr	Ag	N						×		×	
												22				Fr	Jl	N									
	±											23				Fr	My	O				±					±
												24			×	Fr	×	S	O								×
												25				Fr	Ag	O						+			
	±			±	±							26				Fr	Ag	O						±			
												27				Fr	Ag	N						±			
	—											28				Fr	Jl	S				—					
								×				29		×	Fr	×	×	S	O								×
|												30				Fr	Je	Jl					|			|	
				×								31				Fr	Ag	O						×			×
								—				32		—	Fr	—	Ag	S	—								
			—					—				33			Fr	—	—	S	—	O		—					
								×				34	×	×	Fr	×	×	Ag	×	O							
				±	±		±					35				Fr	Jl	O		±							
±				±	±		±				36	±			Fr	Je	S	±		±	±			±	±	±	
												37				Fr	My	Je									
	±			±	±		±	±				38			Fr	Jl	S	±		±	±			±	±	±	
	×		×	×	×							39			Fr	Jl	O	×				×				×	
			×					×				40				Fr	×	Ag	S								
								×	×		×	41	×	×	Fr	×	×	×	×	S	O						
				×								42			Fr	Ag	S	×		×						×	
				×								43				Fr	Ag	S		×							
												44				Fr	Ag	O									
				×			×					45				Fr	×	×	S	×	O				×		
												46				Fr	S	O									
							=					47				Fr	O	=							=	=	
				×			×					48					×	×								×	
											49	×				Fr	Ag	O									
				×						×	50	×				Fr	Ag	O		×							
												51				Fr	Ag	O									

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chenopodium murale	1	—								Fl	Je				
Cycloloma platyphyllum	2									Fl	Jl	Ag			
Salsola Kali Tragus	3									Fl	Ag				
Phytolacca decandra	4				±		±	±	±	Fl	My	Ag	±		±
Fagopyrum esculentum	5	—								Fl	Ag				
Polygonum acre	6									Fl	Jl	S			
Polygonum aviculare	7	×	×							Fl	Jl	S			
Polygonum dumetorum scandens	8									Fl	Je	Ag		×	
Polygonum erectum	9				×					×	Fl	My	Ag		
Polygonum Hartwrightii	10									Fl	Je	S			
Polygonum Hydropiper	11									Fl	Ag	S			
Polygonum hydropiperoides	12									Fl	Jl	S			
Polygonum lapathifolium	13									Fl	Je	S			
Polygonum lapathifolium incarnatum	14									Fl	Je	S			
Polygonum Muhlenbergii	15									Fl	Je	S			
Polygonum Persicaria	16									Fl	Ag	S			
Polygonum virginicum	17									Fl	Jl	S		±	±
Rumex Acetosella	18	±	±	±	±	±				Fl	Ap	Ag	±		
Rumex altissimus	19									Fl	My	Jl			
Rumex crispus	20	±	±	±	±					Fl	My	Jl			
Rumex maritimus	21									Fl	My	Jl			
Rumex obtusifolius	22	±	±							Fl	Je	Jl	±		
Rumex verticillatus	23									Fl	Je	Ag			
Aristolochia tomentosa	24									Fl	My	Je			
Asarum canadense	25									Fl	Ap	My			
Saururus cernuus	26									Fl	Je	Jl			
Lindera Benzoin	27									Fl	Mr	Ap			
Sassafras officinale	28	*							*	*	Fl	Ap	My		*
Comandra umbellata	29								|	|	Fl	Ap	My		
Acalypha caroliniana	30									Fl	Jl	Ag			
Acalypha virginica	31	×	×		×			×		Fl	Jl	Ag		×	×
Acalypha virginica gracilens	32									Fl	Jl	Ag			
Croton capitatus	33			×						Fl	Jl	Ag	×		
Croton glandulosus	34	×								Fl	Jl	Ag	×		
Croton monanthogynus	35	×								Fl	Ag	S	×		
Euphorbia corollata	36							+		Fl	My	Ag			
Euphorbia dentata	37	×		×						Fl	Je	O	×		
Euphorbia glyptosperma	38									Fl	Jl	Ag			
Euphorbia humistrata	39									Fl	Ag	N			
Euphorbia maculata	40	×	×		×					Fl	Je	S			
Euphorbia obtusata	41									Fl	Ag	S			
Euphorbia Preslii	42	×		×	×			×	×	Fl	Je	Ag	×		×
Euphorbia serpens	43									Fl	Jl	N			
Boehmeria cylindrica	44									Fl	Je	Ag			
Cannabis sativa	45	±	±							Fl	Je	Ag			
Celtis mississippiensis	46									Fl	My	Je			
Celtis occidentalis	47						*			Fl	Ap	My			
Celtis pumila	48									Fl	Ap	My			
Humulus Lupulus	49		±		±					Fl	Je	Jl		±	±
Laportea canadensis	50						—			Fl	Je				
Morus rubra	51				*		*	*		Fl	My	Je			*

SOURI													ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
												1				Fr	Jl			—							
											2	×				Fr	Ag	O			×						
												3				Fr	S	D		×							
	±	±		±			±					4				Fr	±	±	Jl	S		±		±			
												5				Fr	S										
												6				×	×	Fr	Ag	O							
									×		7	×			Fr	Ag	O	×							×		
	×				×		×	×				8			Fr	×	×	×	×	Jl	N	×					×
											9	×				Fr	Je	S									
						±		±	±			10	±	±	Fr	±	±	Jl	O								
								×			=	11	×	×		×	×	Fr	×	O							
								×	×		=	12	×	×	Fr	×	×	Ag	×	S							
						±		±	±			13	±	±		±	±	Fr	Jl	O		±					
												14				±	Fr	Jl	±	N							
												15		±		±	Fr	Jl	±	N							
									×			16				Fr	×	S	O								
								±				17				Fr	±	S	O					±			
	±				±		±	±				18				Fr	±	±	My	±	S				±		
								±				19				Fr	±	±	Jl	S							
				±					±			20				Fr	±	Jl	S	±							
												21				Fr	Jl	S				±					
				±								22				Fr	Ag	±	S	±							
						×						23				×	Fr	Ag	×	S							
	±	±										24				Fr	S	O	±			±		±			
	+	+										25				Fr	My	Je	+			+		+			
								+				26	±	±		±	Fr	Ag	±	S							
	*	*										27				Fr	Jl	Ag				*					
	*	*										28				Fr	Jl	Ag				*		*		*	
|	|				|							29				Fr	My	Je					|	|	|	|	
	×											30				Fr	Ag	S									
	×											31				Fr	Ag	S				×		×		×	
	×	×										32				Fr	Ag	S				×					
												33				Fr	S	×	O	×					×		
												34				Fr	S	×	O						×		
												35				Fr	S	×	O						×		
	+											36				Fr	Jl	Ag				+		+			
				×	×							37				Fr	Ag	×	N	×					×		
												38				Fr	×	Ag	S								
				×				×			×	39				Fr	×	S	N	×							×
				×	×							40				Fr	Jl	N		×							
												41				Fr	S	×	O			×		×			
	×		×	×	×		×				×	42			Fr	Jl	O	×	×	×		×		×	×		
				×	×							43			Fr	Ag	N	×		×	×						
												44			Fr	S	×		×					×			
												45			Fr	Ag	S	±									
								*				46		Fr	*	*	*	*	*	S	N	*					*
	*	*					*					47			*	Fr	S	*	N							*	*
*												48				Fr	S	N					*				
		±			±							49				Fr	S	±	O					±			±
								—				50				Fr	—	Ag	S					—			
	*	*					*					51				*	*	*	*	Fr	Je					*	*

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pilea pumila	1									Fl	My	Je			
Ulmus americana	2						*			Fl	Mr	Ap			
Ulmus fulva	3							*		Fl	Mr	Ap			*
Urtica gracilis	4									Fl	Ag	S			
Platanus occidentalis	5						*		Fl	My	*	*			
Carya alba	6							*	*	Fl	My				*
Carya amara	7									Fl	My				
Carya olivaeformis	8									Fl	My				
Carya porcina odorata	9							*	*	Fl	My				*
Carya tomentosa	10							*	*	Fl	My				*
Juglans cinerea	11									Fl	My				*
Juglans nigra	12									Fl	My				*
Betula nigra	13						*			Fl	Ap	My			
Carpinus caroliniana	14						*			Fl	Ap				
Corylus americana	15									Fl	Ap			*	
Ostrya virginica	16							*		Fl	Ap				
Quercus alba	17						*	*	*	Fl	My				*
Quercus bicolor	18									Fl	My				
Quercus coccinea tinctoria	19						*	*	*	Fl	Ap	My			*
Quercus imbricaria	20							*		Fl	Ap	My			*
Quercus macrocarpa	21						*	*		Fl	My				
Quercus macrocarpa olivaeformis	22									Fl	My				
Quercus Muhlenbergii	23							*	*	*	Fl	Ap	My		*
Quercus nigra	24							*	*	Fl	Ap	My			*
Quercus palustris	25									Fl	Ap	My			
Quercus rubra	26							*		Fl	Ap	My			*
Quercus stellata	27							*	*	Fl	Ap	My			*
Quercus Schneckii	28							*	*	Fl	Ap	My			*
Populus monilifera	29									Fl	Ap	My			
Salix amygdaloides	30									Fl	Ap				
Salix amygdaloides × nigra	31									Fl	Ap				
Salix cordata × sericea	32									Fl	Ap				
Salix longifolia	33									Fl	Ap	My			
Salix nigra	34						*			Fl	Ap	My			
Salix sericea	35									Fl	Ap	My			
Juniperus virginiana	36									Fl	Ap				
Elodea canadensis	37									Fl	Je				
Cypripedium pubescens	38							+		Fl	My			+	+
Habenaria virescens	39									Fl	Jl				
Iris versicolor	40								Fl	My	Je	±			
Sisyrinchium albidum	41							+	+	+	Fl	My	+		+
Sisyrinchium anceps	42							+	+	+	Fl	My	+		+
Agave virginica	43									*‡	Fl	Je			
Hypoxis erecta	44							|		Fl	Ap	My			|
Dioscorea villosa	45								±	Fl	Je	Jl		±	
Allium cernuum	46	+		+				+		Fl	Jl	Ag	+		
Allium vineale	47	+								Fl	Ap	My			
Allium stellatum	48									=	Fl	S	O		
Asparagus officinalis	49		±		±					Fl	My				
Camassia Fraseri	50									|	Fl	Ap			|
Erythronium albidum	51						|		Fl	Ap				

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
	±											1				Fr	Ag	S.				±					
	*							*				2	Fr	*	*	*	*	Ap	*	*	My	*					*
	*						*					3			Fr	Ap	My	*	*			*		*			
												4			Fr	×	S	O	×								
								*				5			Fr	*	Jl	D	*								*
												6				Fr	S	O					*	*		*	
												7			*	Fr	S	O									*
								*				8			*	*	Fr	S	O								*
												9				Fr	S	O									
												10				Fr	S	O									*
		*										11				Fr	S	O				*		*			
		*					*	*				12				Fr	S	N						*			
								*	*	*		13	*	*	*	*	*	Fr	*	Ag	N						*
	*	*										14				Fr	Ag	S				*					*
	*	*										15				Fr	S					*					*
	*	*										16			*	Fr	Ag	S				*		*			
		*										17				Fr	Ag	S						*			
								*				18		*	*	Fr	*	Ag	*	S							
	*	*										19				Fr	S	*	O			*		*			
							*					20				Fr	S	*	O			*					
	*	*					*	*				21			*	Fr	*	*	*	S	O	*		*			*
								*				22			*	Fr	*	*	*	S	O	*		*			*
*	*	*										23			Fr	Ag	S	*	*					*			
												24				Fr	S	O						*			
								*				25		*	Fr	*	*	S	O								
												26			Fr	S	O	*	*					*		*	
												27				Fr	S	O						*		*	
												28				Fr	S	O						*		*	
	*						29	*	=	*	=	*		*	*	*	Fr	Je	*								
												30	*	*	*	*	Fr	Je	Jl								
												31		*	*	Fr	Je	Jl									
								*		*		32		*	*	*	Fr	Je	*	Jl							*
							33	*	=	*	=	*		*	*	*	Fr	Je	*	Jl							
								*		*		34		*		*	Fr	Je	Jl								*
								*				35		*		*	Fr	My	Je								
*‡												36				Fr	S	O					*‡				
												37				±											
		+										38				Fr	Jl	Ag						+			
												39				Fr	Ag					—		—			
						±		±				40		±		±	Fr	Jl	Ag								
					+							41				Fr	Je	Jl					+	+	+	+	
					+							42				Fr	Je	Jl					+		+	+	
*‡												43				Fr	Ag	S					*‡			*‡	
												44				Fr	My	Je						|		|	
	±				±							45				Fr	S	±			±	±		±		±	
				+				+				46			+	+	+	+	Fr	Ag				+	+	+	
												47				+	+	Fr	Je	+	Jl				+		
		=										48				Fr	O										
				±	±							49				Fr	Ag	S		±	±						
		|										50				Fr	My	Je					|				
		|						|				51				Fr	|	My						|			

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hemerocallis fulva	1		±		±					Fl	Je				
Lilium canadense	2									Fl	Je				
Nothoscordum striatum	3								|	|	Fl	Ap			
Polygonatum giganteum	4							±		Fl	±	My	Je		±
Smilacina racemosa	5							±		Fl	±	My	Je		±
Smilax ecirrhata	6									Fl	My			±	
Smilax herbacea	7						±			Fl	My	±	Je	±	±
Smilax hispida	8						±			Fl	My	±	Je	±	±
Trillium erectum	9									Fl	Ap	My			
Trillium recurvatum	10						|	|		Fl	Ap	|	My	|	|
Trillium sessile	11						|	|		Fl	Ap	|	My	|	|
Uvularia perfoliata	12						+	+			Fl	Ap			
Heteranthera graminea	13									Fl	Jl	—			
Heteranthera limosa	14									Fl	Jl	—			
Heteranthera reniformis	15									Fl	Jl				
Pontederia cordata	16									Fl	Je	±	S		
Commelina communis	17		±				±			Fl	Ap	±	S		
Commelina virginica	18						±			Fl	±	±	Jl	O	
Tradescantia virginica	19						±	±		Fl	±	My	±	Jl	±
Juncus acuminatus	20									Fl	My	Je			
Juncus acuminatus robustus	21									Fl	My	Je			
Juncus dichotomus	22									Fl	My	Je			
Juncus marginatus	23									Fl	Je	Jl			
Juncus nodosus megacephalus	24									Fl	Je	Jl			
Juncus tenuis	25	±	±	±	±	±			±	Fl	My	Ag			±
Luzula campestris	26									Fl	Ap	My			+
Sparganium eurycarpum	27									Fl	My	Jl			
Sparganium simplex androcladum	28									Fl	My	Jl			
Typha latifolia	29								Fl	My	Je	±			
Acorus Calamus	30									Fl	Ap	My			
Arisaema Dracontium	31						±	±	Fl	Ap	±	±	Je	±	±
Arisaema triphyllum	32						±	±	Fl	Ap	±	±	Je	±	±
Peltandra undulata	33									Fl	My	Je			
Lemna minor	34														
Lemna perpusilla	35											—			
Lemna perpusilla trinervis	36														
Lemna trisulca	37														
Spirodela polyrrhiza	38											×			
Wolffia punctata	39											—			
Alisma Plantago	40					±			Fl	Jl	S	±			
Echinodorus radicans	41									Fl	Jl	Ag			
Echinodorus rostratus	42									Fl	Jl	Ag			
Sagittaria calycina	43									Fr	Je	±	S		
Sagittaria graminea	44									Fr	Je	±	S		
Sagittaria heterophylla	45									Fr	Je	±	S		
Sagittaria variabilis	46									Fr	Je	±	S		
Sagittaria variabilis latifolia	47									Fr	Je	±	S		
Potamogeton hybridus	48									Fl	Ap	My			
Potamogeton illinoensis	49									Fl	Ap	My			
Carex cephalophora	51							+		Fl	My	Je			+
Carex conjuncta	51							+		Fl	My	Je			+

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
				±								1								±							
												2				Fr	Jl	Ag		+					+		
|												3				Fr	My							|			
	±	±		±	±							4				Fr	Jl	Ag				±		±			
	±	±		±	±							5				Fr	Je	Jl				±		±			
	±				±							6				Fr	S	O				±					
	±			±								7				Fr	Ag	S	±			±		±			±
	±			±								8				±	±	Fr	±	Ag	O			±			±
	|											9				Fr	Je	Jl									
	|											10			|	Fr	Je	Jl	|			|		|			|
	|											11			|	Fr	Je	Jl	|			|		|			|
	+	+										12				Fr	My	Je				+		+			+
						—						13				—	Fr	Ag	—								
						—						14	—			—	Fr	Ag	—								
												15	—			—	Fr	Ag									
												16				Fr	Jl	S	±								
		±	±			±						17				Fr	±	Ap	N								±
		±	±			±						18				Fr	±	Ag	N	±							±
	±	±		±	±		±	±				19	Fr	Je	Ag	±	±	±	±	±	±	±		±	±	±	±
						+						20			Fr	+	Je	Jl	+								
						+						21			Fr	+	Je	Jl	+								
						—						22				Fr	Jl	Ag									
												23		—	Fr	—	Jl	Ag	—								
										×	24	×				Fr	Jl	S									
			±						=		=	25			Fr	Je	S	±								±	
												26				Fr	Je	Jl	+					+		+	
						±						27	±		Fr	±	Jl	Ag	±								
												28	±		Fr	±	Jl	Ag	±								
			±			±						29	±	±	Fr	±	Jl	O	±								
												30		±	Fr	±	Jl	Ag	±								
	±	±										31			±	±	Fr	S	O			±		±			±
	±	±										32			±	±	±	Fr	S	O		±		±			±
						+						33	+		Fr	+	Ag	S	+								
			—									34				—	Fr	Je									
			—									35				—	Fr	Ag									
												36				—	Fr	Ag									
												37				—											
						×						38					×			×							
												39				—											
			±			±		±				40	±	Fr	±	±	S	O	±								
												41			Fr	×	Ag	S		×							
												42	±	±	Fr	±	Ag	S									
						±						43	±	±	Fr	±	Jl	Ag	±								
						±						44	±	±	Fr	±	Jl	Ag	±								
						±						45	±	±	Fr	±	Jl	Ag	±								
			±			±						46	±	±	±	±	Fr	Jl	±	Ag							
						±						47	±	±	Fr	±	Jl	Ag	±								
												48			Fr	±	Je	Jl	±								
												49			Fr	±	Je	Jl	±								
		+										50				Fr	Jl	Ag		+				+		+	
		+						+				51			Fr	Jl	Ag	+		+				+			

DISTRIBUTION AND PHENOLOGY		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Carex Crus-Corvi	1									Fl	My	Je			
Carex Davisii	2									Fl	Ap	My			
Carex granularis	3						+			Fl	Ap	My			
Carex gravida	4									Fl	Ap	My			
Carex grisea	5								+	Fl	Ap	My	+		
Carex Jamesii	6							+		Fl	Ap	My		+	
Carex laxiflora	7						±			Fl	Ap	My			
Carex laxiflora latifolia	8							±		Fl	Ap	My			±
Carex lupulina	9					±				Fl	Je	Jl			
Carex monile	10									Fl	My	Je			
Carex oligocarpa	11							+	+	Fl	Ap	My			
Carex pennsylvanica	12							+		Fl	Ap	Je			
Carex riparia	13					+				Fl	Ap	My			
Carex Shortiana	14					+	+	+		Fl	Ap	My			+
Carex sparganioides	15					+				Fl	Ap	My			
Carex squarrosa	16					+				Fl	My	Je			
Carex straminea	17					+				Fl	Ap	My			
Carex tribuloides	18									Fl	My	Je			
Carex tribuloides cristata	19									Fl	My	Je			
Carex vulpinoidea	20					±				Fl	My	Je			
Cyperus acuminatus	21								Fl	Jl	Ag	×			
Cyperus aristatus	22									Fl	Jl	Ag			
Cyperus diandrus	23									Fl	Jl	Ag			
Cyperus erythrorhizos	24	±				±			Fl	My	S	±			
Cyperus esculentus	25	±							Fl	My	S				
Cyperus filiculmis	26								Fl	My	S				
Cyperus ovularis	27	±		±					Fl	My	S				
Cyperus Schweinitzii	28								Fl	Je	Ag				
Cyperus speciosus	29								Fl	Je	Ag				
Cyperus strigosus	30								Fl	Je	Ag				
Dulichium spathaceum	31								Fl	Jl	S	×			
Eleocharis acicularis	32								Fl	My	O	±			
Eleocharis compressa	33								Fl	My	Jl				
Eleocharis ovata	34								Fl	My	O				
Eleocharis tenuis	35					+			Fl	+	Ap	My			
Eriophorum lineatum	36					+			Fl	My	Je				
Fimbristylis autumnalis	37								Fl	Je	S				
Scirpus atrovirens	38								Fl	Ap	Jl				
Scirpus fluviatilis	39								Fl	Je	Jl				
Scirpus lacustris	40								Fl	Je	O				
Agropyrum repens	41								Fl	Je	Jl				
Agrostis alba	42	±		±	±	±			Fl	Je	Jl		±		
Agrostis scabra	43	+			+			+	+	Fl	Ap	My	+		+
Alopecurus geniculatus	44	+		+		+				Fl	Ap	My			
Andropogon furcatus	45								×	×	Fl	Ag	×	S	
Andropogon scoparius	46								+	+	Fl	Ag	×	S	
Aristida oligantha	47	×		+						Fl	Jl	S			
Asprella Hystrix	48							×		Fl	Je	Jl			×
Avena sativa	49	+	+		+					Fl	My				
Bouteloua racemosa	50									×	Fl	Jl	S		
Bromus secalinus	51	+		+	+					Fl	My	Je			

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1		+	Fr	+	+	Je	+	Jl							
												2				Fr	+	Je	Jl								+
		+						+				3			+	+	+	Fr	+	Je	Jl						+
												4				+	Fr	Je	Jl								
												5				Fr	My	Je							+		
												6				Fr	My	Je								+	
	±											7			±	±	±		±	±		±					±
	±	±										8				Fr	Je	Jl				±		±		±	
			±									9		±	Fr	±	Ag	N	±								
			+					+				10		+	Fr	+	+	Jl	+	Ag							
												11				Fr	My	Je						+		+	
		+										12				Fr	Jl	Ag				+				+	
			+			+						13		+		+	Fr	My	+	Je							
		+	+			+						14				Fr	Je	Jl									+
			+			+						15		+		+	Jl	Ag	+								
			+			+						16		+		+	Jl	Ag	+								
			+			+						17		+		+	Je	Jl	+								
												18		+	Fr	+	Jl	Ag	+								
												19		+	Fr	+	Jl	Ag	+								
			±			±						20		±	Fr	±	Jl	Ag	±								
			×			×			×		21	×	×			×	Fr	S	×	O							
									22	×	=	×	×			Fr	S	O									
								23	×	×	=	×				Fr	S	O									
			±			±						24	±	±	Fr	±	Jl	O	±								±
												25			Fr	Jl	O	±									
												26			Fr	Jl	O	±									
							±					27			Fr	Jl	O	±									
										×	28	×			Fr	Ag	S	×									
										×	29	×			Fr	Ag	S	×									
										×	30	×			Fr	Ag	S	×									
						×						31			Fr	×	S	O	×								
						±						32			Fr	±	Jl	O	±								
												33	±		Fr	±	Jl	S	±								
			±			±						34	±		Fr	±	Jl	O	±								
			+				+					35				Fr	+	Je	Jl	+							
			+			+						36		+	Fr	+	+	Jl	+	Ag							
			×						×		×	37				Fr	×	S	N								
								±				38				Fr	±	My	S								
												39		±	Fr	±	Ag	S	±								
						±						40	±		Fr	±	±	Ag	±	O							
				±	±							41				Fr	Ag	S		±	±						
			±									42				Fr	±	Ag	S	±					±		
							+					43				Fr	My	+	Je					+	+	+	
						+		+				44				+	+	Fr	+	Je	Jl						
												45			Fr	S	O	×							×	×	
												46			Fr	S	O	×							×	×	
					×						47	×			Fr	S	O	×							×	×	
	×	×		×								48				Fr	Ag	S				×		×		×	
				+								49				Fr	Je	Jl									
×												50				Fr	Ag	O					×		×		
				+	+							51			Fr	Jl	Ag	+								+	

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cenchrus tribuloides	1									Fl	Je	Ag			
Dactylis glomerata	2	±	±	±	±					Fl	My	Ag			
Danthonia spicata	3								+	+	Fl	Ap	+	My	
Diplachne fascicularis	4									Fl	Jl	S			
Eatonia obtusata	5									Fl	Je	Jl	×		
Eatonia pennsylvanica	6							+		Fl	Ap	My			+
Eleusine indica	7	±	±	±						Fl	My	S			
Elymus canadensis	8									Fl	Je	Jl			
Elymus striatus	9	±			±		±			Fl	My	Je	±		
Elymus virginicus	10	±			±					Fl	Ap	My		±	
Eragrostis reptans	11									Fl	Ag	S			
Festuca tenella	12								+	Fl	Ap	My	+		
Glyceria nervata	13					+			Fl	Ap	My	+			
Hordeum jubatum	14			+						Fl	Ap	My			
Koeleria cristata	15									Fl	Ap	My			
Leersia oryzoides	16								Fl	Jl	Ag	×			
Leersia virginica	17									Fl	Jl	Ag			
Melica diffusa	18							|		Fl	Ap	My			|
Muhlenbergia diffusa	19							×		Fl	Jl	Ag			×
Muhlenbergia glomerata	20									Fl	Jl	Ag			×
Muhlenbergia sobolifera	21							×		Fl	Jl	Ag			×
Panicum Crus-galli	22					±				Fl	Jl	S			
Panicum depauperatum	23								+	+	Fl	Ap	My		
Panicum filiforme	24							±		Fl	My	Je			±
Panicum proliferum	25	±	±							Fl	Jl	Ag			
Panicum sanguinale	26	±	±	±	±					Fl	Jl	S			
Paspalum fluitans	27									Fl	Jl	Ag			
Phalaris canariensis	28									Fl	Jl				
Phleum pratense	29	±			±					Fl	Je	S	±		
Phragmites communis	30									Fl	Ag	S			
Poa annua	31	+	+	+	+					Fl	Ap	My			
Poa compressa	32	+	+	+	+					Fl	Ap	My	+		
Poa pratensis	33	+	+	+	+		+			Fl	Ap	My	+		
Setaria glauca	34	×								Fl	Jl	Ag			
Setaria italica	35	×								Fl	Jl	Ag			
Setaria viridis	36	×								Fl	Jl	Ag			
Sorghum Halepense	37									Fl	Je	Jl			
Spartina cynosuroides	38									Fl	Jl	Ag			
Sporobolus asper	39									Fl	Ag	S			
Sporobolus vaginaeflorus	40									Fl	Ag	S			
Triodia cuprea	41			×	×					Fl	Ag	S			
Uniola latifolia	42							×		Fl	Jl	S			×
Zea Mays	43	×	×							Fl	Je	Jl			
Equisetum arvense	44						+								
Equisetum laevigatum	45														
Equisetum robustum	46														
Adiantum pedatum	47						±				±				±
Aspidium acrostichoides	48										±				±
Aspidium marginale	49								±						
Asplenium angustifolium	50														
Asplenium ebeneum	51														

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
				×							1	×			Fr	Ag	O	×			×						
				±								2				Fr	Jl	O		±							
+												3				Fr	Je	Jl					+		+	+	
											=	4		×		Fr	Ag	O									
												5				Fr	Ag	S								×	
	+											6				Fr	Je	Jl				+		+		+	
				×								7				Fr	Jl	S		×							
	±			±	±							8				Fr	Ag	O		±	±	±					
				±	±		±					9				Fr	Ag	±	S						±		
				±	±			±				10				Fr	±	Ag	S	±	±			±			
						×		×	×		×	11				×	Fr	S	×	O							
												12				Fr	My	+	Je					+		+	
						+						13		+		+	Fr	Jl	+	Ag							
								+				14				Fr	Je	+	Jl								
+												15				Fr	My	Je					+			+	
						×						16				×	Fr	Ag	S								
								×				17			×	Fr	Ag	S						×			
|	|											18				Fr	My	Je				|	|	|			
	×											19				Fr	S	O						×			
	×											20				Fr	S	O				×		×			
×	×	×										21				Fr	S	O					×	×		×	
			±			±		±				22	±	±		±	±	Fr	±	Ag	O						
+												23				Fr	Je	Jl					+				
	±						±					24				Fr	Jl	±	Ag			±		±		±	
												25				Fr	±	S	O								
				±	±							26				Fr	Ag	±	N	±							
											=	27				×	Fr	S	×	O							
				×								28				Fr	Ag	S									
				±			±					29			Fr	Ag	±	±	O	±	±				±		
												30							±								
				+	+		+					31				Fr	My	+	Je	+	+						
				+	+							32				Fr	Jl	Ag		+	+						
				+	+		+					33				Fr	Je	Jl		+	+					+	+
				×								34				Fr	S	O		×							
				×								35				Fr	S	O		×							
				×								36				Fr	S	O		×							
					×							37				Fr	Ag	S		×							
						×		×	×			38		×	Fr	×	×	S	×	O							
×	×											39				Fr	S	O				×	×				
×	×										40	×				Fr	S	O				×	×				
				×	×							41				Fr	S	O		×	×						
	×	×										42				Fr	Ag	O				×		×			
												43				Fr	Jl	S									
				+	+							44			Fr	Ap	My	+								+	
								|			45	|				Fr	|	Je	Jl								
								±	±		=	46	±	±	Fr	±	Jl	Ag	±								
	±	±										47				Fr	Jl							±			±
		±										48				Fr	Je	Jl						±			
±												49				Fr	Jl	Ag					±				
												50				Fr	Jl	Ag						±			
	±	±										51				Fr	Jl	Ag				±					

DISTRIBUTION AND PHENOLOGY		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Asplenium thelypteroides	1														
Cheilanthes lanuginosa	2														
Comptosorus rhizophyllus	3							*‡							
Cystopteris bulbifera	4														
Cystopteris fragilis	5						±				±				
Onoclea sensibilis	6														
Pellaea atropurpurea	7														
Phegopteris hexagonoptera	8							±							±
Pteris aquilina	9								±	±					±
Woodsia obtusa	10														±
Botrychium virginianum	11														+
Ophioglossum Engelmanni	12									+					
Isoetes melanopoda	13														
Azolla caroliniana	14														

SUMMARY.

The area covered is too small to attach importance to a variation in climatic factors, i. e., seasonal means and extremes of temperature, the amount and distribution of rainfall, the humidity of the air and the movements of the atmosphere, factors which determine the type of the vegetation and the type of the flora,* as influencing the distribution of the different local species through the various regions which may be distinguished in the section studied. Where most conditions are fairly uniform, as for instance on the western plains or the plateaus of the Yellowstone, the presence of any plant, and modifications of its habit, its morphological, phenological and even minute physiological characters, may frequently be ascribed to modifications of a single factor. The physical condition, including color, of the soil, and the amount of water present and available, the presence or absence of a single element, variation in the amount of another, differences in the amount or nature of light, the direction and intensity of the prevailing winds, altitude and a number of other factors, yield instances too well known to require repetition here. But where conditions are diversified the agency of a single factor is no longer a

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* Schimper, A. F. W. Pflanzengeographie. 174. 1898.

SOURI											ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	$\underline{12}$	12	20	21	22	23	26	25	14	11	12	$\underline{12}$	$\underline{11}$	18	24	16	15	14	12	7	6
												1				Fr	Jl	Ag						±			
±												2				Fr	Je	Ag					±				
*‡	*‡											3				Fr	Je	S				*‡	*‡	*‡			
												4				Fr	Jl	S					±				
	±	±										5				Fr	Jl	S					±				±
	±							±				6		±		Fr	±	Ag	S			±					
*‡												7				Fr	Jl	S					*‡				
	±	±										8				Fr	Jl	S				±		±		±	
												9												±			
±	±	±										10				Fr	Jl	S				±	±	±			
	+	+										11				Fr	My	Je	+			+					
												12				Fr	My	Je									
												13		×					×								
												14				×	Fr	Jl	Ag								

sufficient explanation. A large number of factors must be taken into consideration and under such conditions it frequently becomes a matter of personal bias or of greater knowledge in a chosen field whether to one factor or another the preponderating influence is ascribed. When Cowles, in his Physiographic Ecology of Chicago, presented a physiographic theory, he was able to combine the different factors in one great whole, since physiographic forces, in their widest sense, acting upon the surface of the globe, determine not only the physical and chemical nature of the soil and the topography, but by influencing the local distribution of plant life, also influence the amount and character of light received and the temperature. The term "physiographic forces in their widest sense" is used, for it is clear that while they acted upon geological formations, the very nature of the latter has governed the extent of their influence which was and is less far reaching where they act upon igneous rock than where lime or sandstones are concerned. Again, certain limestones are acted upon far more readily than are others, and the position of the strata is an important factor. But apart from similar initial conditions it would seem that physiography is and was the most important factor. This certainly is the case in the region under consideration. For in a measure it has determined the chemical nature of the soil, being responsible for the absence of loess in certain portions of the territory (cliffs), for the presence of colluvial soil (at the base of slopes), for the presence of wide stretches of sand (in the bottomlands of the Mississippi), etc. It further governs the amount of soil water, being directly responsible for the xerophytic character of the upper portions of more recent ravines as contrasted with the mesophytic conditions prevailing in other portions. In thus influencing vegetation, physiography also modifies light and temperature, thereby inducing still other changes in the plant associations.

By ascribing to physiography in its widest sense the diversity shown by the flora in different regions, the issue has merely been postponed, for it remains to be decided which of the factors subordinate to physiography is of greatest influence. The question is one difficult to answer, for it would seem that now one factor, then another, is of greatest importance. Besides, plants possess an immense power of adaptation to their surroundings and are able to support a great variation in the degree of any one factor. This is best illustrated by greenhouse plants, originally growing under the most diverse conditions, which vegetate side by side in uniform surroundings and even flourish when sufficient space is given. But this is true for adult plants only. Seedlings are far more exacting, especially in regard to proper conditions of temperature and soil humidity. The chemical condition of the soil seems to be of the slightest importance. This statement applies to the majority of soils, for though their composition may vary greatly, it is but seldom that one or more substances are present which, because of their presence or the amount in which they are present, directly or indirectly either retard germination or so affect the seedling as to severely injure it or prohibit its very existence. The salty lands of sea-coast marshes and the alkali lands are exceptions to this rule. Comparatively few species can exist here. While cultivated plants with a few notable exceptions are affected by the salts of the alkali lands, there are a number of native species which flourish on them.* Alkali lands, however, being limited to regions with deficient rainfall, need not be considered here. But it is different where the quantity of lime in the soil is concerned. Though the loess is bedded on the limestone, the thickness of the former is often so great that the substratum is of no influence on the top soil. but most of the colluvial soil and the soil of the bottom lands comes under its influence. The analysis of the bluff soil, given in a former chapter, shows a very fair percentage of limestone,* though to attain the highest productiveness twice the amount would probably be necessary. Not only is the presence of lime in a soil beneficial, since, as before mentioned, it increases the amount of humus and causes the soil to assume a darker color, but according to the experiments of Liebenberg it is beneficial to germination. His results agree with those obtained by Claudel and Crochetelle,† whose experiments are discussed by Hicks,‡ who, in a resume of the work of the French investigators says:

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* Hilgard, E. Soils. 430.

"Alkaline substances with a basis of lime or of potash favored in a marked degree the germination of certain seeds, notably those of the Leguminosae. The slag used produced better effects than the lime alone.

"In the same paper the authors give the results of experiments conducted to obtain information concerning the acids set free or originating during the germination of seeds, which showed that the amounts of acids thus formed are sometimes very great; hence it is concluded that lime, slag, and liquid manure act by saturating these acids in proportion to the amounts formed. Also, that the loss of phosphoric acid, which is excreted in considerable amount in the germination of wheat, for instance, is hindered by these alkaline substances, and thus conserved for the use of the young plant. These conclusions, in the opinion of Claudel and Crochetelle, explain to a certain extent the beneficial effect of lime, slag, and ashes upon acid soils. Seeds of clover were found to produce more acid for a given weight than any other seeds studied, thus explaining the fact that clover does not appear in acid soils prior to the addition of lime, ashes, or slag."

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* Hilgard, E. Soils. 497.

† Annales Agronomique. 131. 1896.

‡ Hicks, G. H. The germination of Seeds as affected by certain Chemical Fertilizers. U. S. D. A. Div. Bot. Bul. 24. 1900.

Hicks, in his own experiments, came to the conclusion that unless an excessive amount of lime is applied, this substance is helpful to germination. There remains, of course, the question of calciphile and calcifuge plants, but Hilgard,* again calls attention to the fact that while in certain regions a plant may be calciphile, in others it may be indifferent.

For these reasons it would seem that in the present instance we may safely ignore the question of the chemical condition of the soil, and that, in this region, under physiography, water is the most important factor in determining the nature of the vegetation. For though, to a certain extent dependent on the physical and chemical nature of the soil, in most cases it is of greater influence than either and also directly and indirectly modifies the temperature of both soil and air.

The correctness of this assumption seems to be borne out by the history of the country studied, which, briefly recapitulated, is as follows. It formed originally part of an extensive peneplain, which, in pre-glacial times, was divided into an eastern and western portion by the trough of the Mississippi. After the glacial period the land, at that time at a considerably lower level, was covered by extensive and slowly moving bodies of water which deposited a fine, almost impalpable sediment, the loess. As the result of a general uplifting, the loess was exposed and the Mississippi excavated its channel, the position of which has changed in the course of time, shifting towards the Missouri shore. It is not to be supposed that the land, at the time of the uplifting, presented a uniformly level surface. As the bottom of a lake shows areas of greater and less depth, so the plateau probably possessed a more or less uneven surface. Long, gentle slopes alternated with larger or smaller level stretches. This surface was further furrowed by the physiographic forces which continue to exert their influence to the present day. The water of precipitation cut miniature cañons in the loess. These, especially where abutting on the bluff, became wider and extended farther inland, forming ravines. The ravine, often assisted by the settling of the earth crust through the breaking down of the roofs of caverns, gradually became wider and acquired gentler slopes. This action continues till base level is reached.

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* Soils. p. 521. See also Science n. s. **37**: 140. Ja. 24. 1907.

It is probable that at first the entire upland was covered by innumerable shallow pools of varying extent, which in the course of time became so shallow that, at least during a portion of the year, they were dry or nearly so. The higher portions, situated at best a few feet above the water level, formed islands, soon occupied by grasses and sedges. These in a short time became associated with other phanerogams, chiefly annuals and biennials, such as *Artemisia*, *Xanthium* and *Oenothera* and which, if not the same species as those occurring to-day, were at least closely related. Willows, hackberries, coffee trees, birches and poplars followed, with here and there an ash. All of these, as the land became drier were replaced by elms, hickories and finally by oaks. Naturally the succession in the greater, submerged portion of the plateau did not take place as rapidly. The conditions existing at that time are, perhaps,to be compared with those we meet with to-day in the lowlands of the Mississippi. The typical lake flora, at first entirely limited to algae, later probably consisted chiefly of *Polygonum*. The edges were occupied by rushes and sedges. These, encroaching upon the water, and by their decay raising the level of the lake bottom, gave the willows an opportunity to gain a foothold. Or circumstances may have arisen by which an entire lake was suddenly drained. In that case there probably sprang up an extensive growth of *Forestiera*. Both willows and *Forestiera* in time came to be replaced by others till finally the oak stage was reached. It is the stage reached at the present day and represents a condition which probably has existed for thousands of years. Yet evidence is not wanting that the oaks in their turn will be replaced by other trees such as sassafras and maple.

A succession like the one just described can be traced from the islands of the Mississippi to the different parts of the

American Bottom. All stages are represented at the mouth of the River des Pères in what is known as Horn's Grove (plates 18, 19). It shows that the nature of the soil has been an unimportant factor. Willows form the first woody vegetation on the sandbars, islands and shores of the Mississippi, as they do on the clayey bottoms or on the swampy uplands (plate 14, 1).

But have we a right to assume that the first beginning of plant growth in this region took place under the climatic conditions which prevail to-day? Perhaps the vegetation began with the retreat of the ice field. It is but reasonable to suppose, judging from conditions such as exist at the present day, for instance in Alaska, that the terminal moraine harbored at first a number of low growing arctic plants, followed by willows with a temporary climax of pine, hemlock and spruce. Evidence is lacking that any of the latter have occurred here, but the lack of such evidence is not conclusive. The conditions necessary for petrifaction were absent. Even had they existed, all remnants of an earlier flora would have been removed by the subsequent action of the waters as shown by their influence on the drift. The existence of a flora towards the end of the glacial period is of little interest in the present connection since there was no genetic continuity between it and the flora of to-day. Between the two lies the most recent period of submergence. Judging from the thickness of the loess, so long a time must have elapsed during its deposition, that when the ground became elevated, a climate must have existed not differing materially from that which prevails to-day.*

This tentative explanation of the forest growth, both in the bottom land and on the plateau, does not throw light upon the small patches of prairie which here and there occur in both regions. From early days the origin of prairies has been a source of speculation and many ingenious theories have been brought forward. Of special interest are the papers of Gray*, Lesquereux† and Henry Engelmann.‡ The prairies of this region differ from those of the western United States, which find their origin in climatic conditions, in being due to local conditions, more particularly to the water relations. An examination of the limited prairies of the Missouri plateau shows them to have been swamp areas.

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* In connection with this see the interesting papers of Adams and others, references to which may be found in Adams, C. C. The post-glacial Dispersal of the North American Biota. Biol. Bull. **9** : 53. 1905.

A study of the flora renders apparent the existence of three sharply defined physiographic regions, viz., the upland, the lowland and the river, in each of which an apparent equilibrium has been reached. Modifications of these regions, either the result of the influence of man or the action of natural forces, forms connecting links between them. Such are the swamps, the ravines, the sandbanks. In some, such as in the older ravines, changes in the apparent equilibrium are so slow as to be almost imperceptible. Here the sequence of events must be arrived at through analogy. In others, and this is true especially for the swampy regions, the changes may be exceedingly rapid, especially where man assists nature. Water content of the soil seems to play the most important part. Under the influence of man, the components of the original flora have undergone certain changes. Species have disappeared, others not only have taken their places but are attempting to take the place of others. The plants so active are mainly cosmopolitan. It is improbable that more than a small percentage of the original flora will disappear through their influence. The immigrants are limited chiefly to territory now under the influence of man. Under this influence the entire flora will not be destroyed, for in portions set aside for special purposes the original flora will persist at least until such a time as the entire region shall have reached base level.

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* Gray, A. Forest Geography and Archeology. Am. Journ. Sc. and Arts. 3 ser. **16** : 85. 1878.—Géographie et Archéologie Forestières. Ann. Sc. nat. 6 sér. Bot. **7** : 126. 1878.

† Lesquereux, L. On the Origin and Formation of the Prairies. Geol. Surv. 111. **1** : 238. 1866.

‡ Engelmann, H. Remarks Upon the Causes Producing the Different Characters of Vegetation Known as Prairies, Flats and Barrens in Southern Illinois, with Special Reference to Observations made in Perry and Jackson Counties. Am. Jour. Sci. and Arts. 2 ser. **36** : 384. 1863.

EXPLANATION OF PLATES.

Plate 10.—The Missouri shore at Selma, 42 miles south of St. Louis, showing the oak-covered plateau, the bare upper portion of the limestone cliffs and the vegetation-covered talus at the base, the railroad embankment and the shelving beach of the Mississippi.

Plate 11.—The Mississippi River at Selma, showing islands with their adjacent mudbanks. In the distance lie the wide and level stretches of the American Bottom.

Plate 12.—1, Upland pond near the edge of the bluff in the woods south of the buildings at Jefferson Barracks. 2, Projecting limestone ledge of the bluff south of Jefferson Barracks. The tree is *Fraxinus viridis.* Stems of *Tecoma radicans* run over the stone. Two plants of *Solidago Drummondii* and one of *Pellaea atropurpurea* have established themselves in crevices.

Plate 13.—Sinkhole vegetation, in this case consisting mainly of *Hydrastis canadensis,* which is in fruit. In the lower right hand corner can be seen leaves of *Arisaema triphyllum* and in the center a plant of *Arisaema Dracontium.* To the right of this are two plants of *Smilacina racemosa* and in the upper right hand corner two plants of *Podophyllum peltatum.*

Plate 14.—1, Upland swamp in the woods south of the buildings at Jefferson Barracks. The wide flat is covered with willows. Along the edges other plants appear, especially *Iris versicolor* and ferns. 2, *Convolvulus Sepium* twining among willows in the "bottoms" on the Missouri side of the Mississippi.

Plate 15.—1, "Bluff quarry" along the Mississippi river bluffs south of Jefferson Barracks, showing the projecting limestone ledges along the railroad track. On the left may be seen the thick covering of loess, deposited on the limestone during the Quaternary period. 2, Mouth of a creek south of Jefferson Barracks, showing the almost horizontal stratification of the St. Louis limestone at this point and the erosion due to the continued action of a comparatively small amount of water.

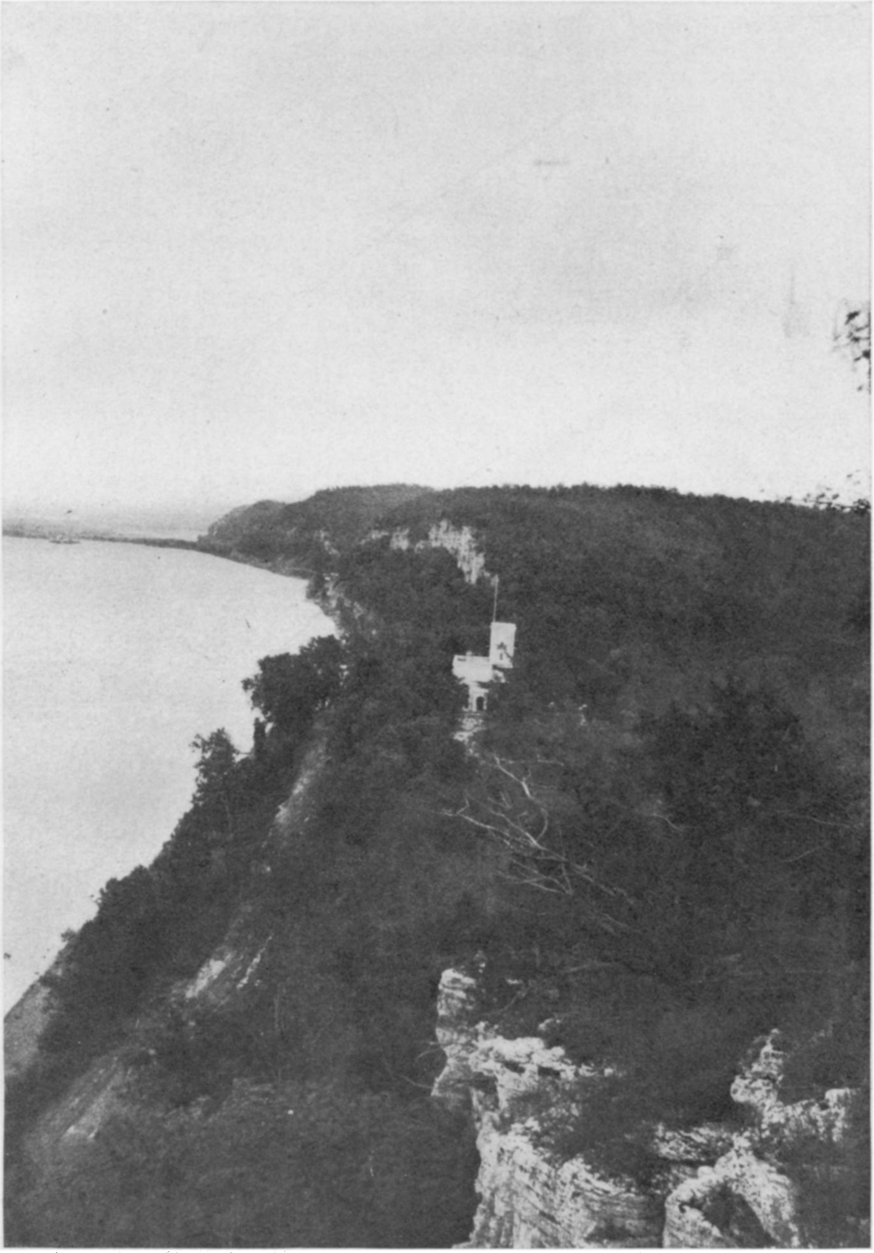
Plate 16.—Partially cut and burned vegetation on the railroad embankment near Jefferson Barracks, the growth consisting chiefly of *Rhus glabra.*

Plate 17.—*Polygonum Hartwrightii* in the wet bottoms of the Mississippi river near Jefferson Barracks.

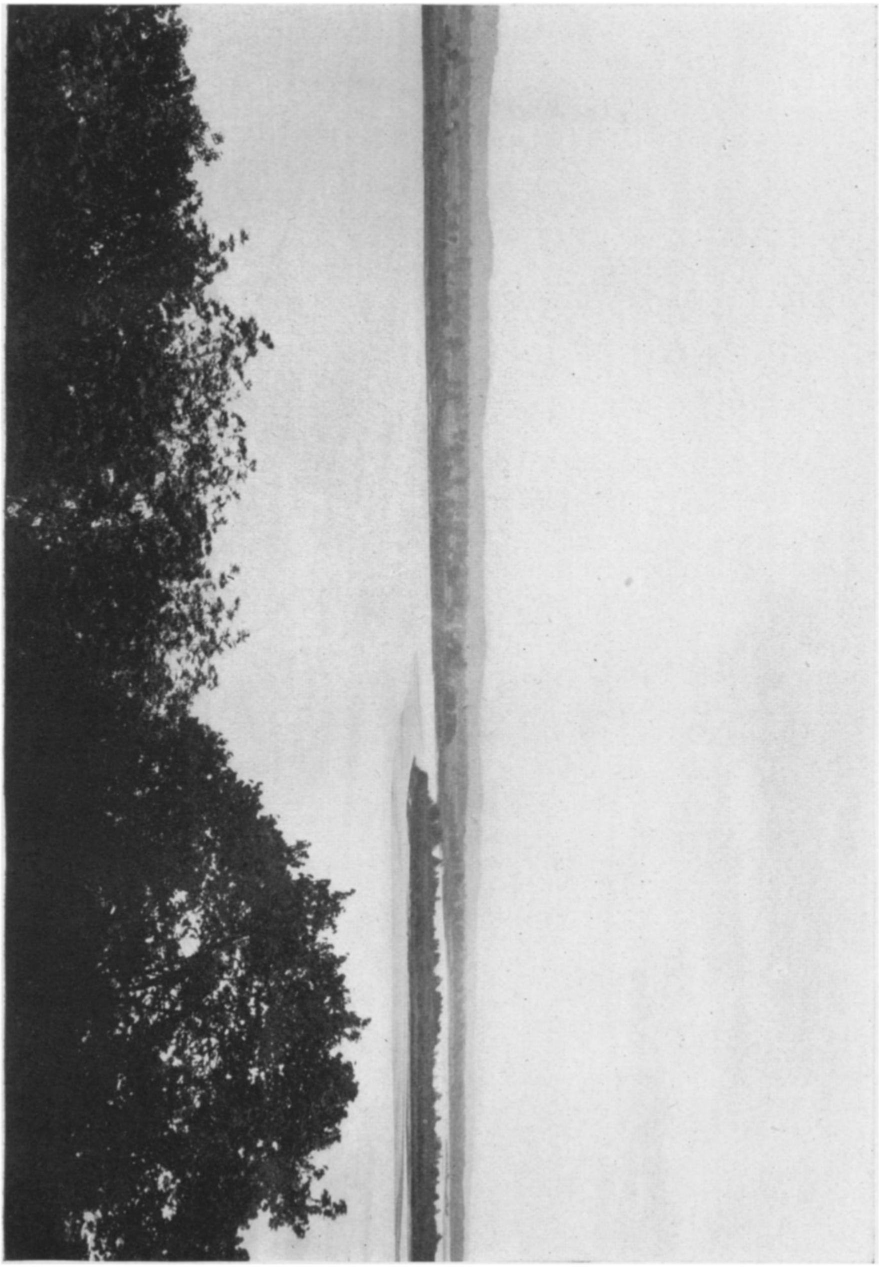
Plate 18.—River des Pères and the adjoining bottoms east of the Broadway bridge. On the right is seen a dense growth of willows; in the center, clumps of *Forestiera acuminata.* In the distance, at the left, is a bank covered with oaks.

Plate 19.—Detail of the preceding plate. 1, Clump of *Forestiera acuminata;* at the left a single tree of *Gleditschia triacanthos.* 2, On the right, willows; on the left, *Ulmus americana;* plants of *Vernonia noveboracensis* and of *Forestiera acuminata* in the foreground.

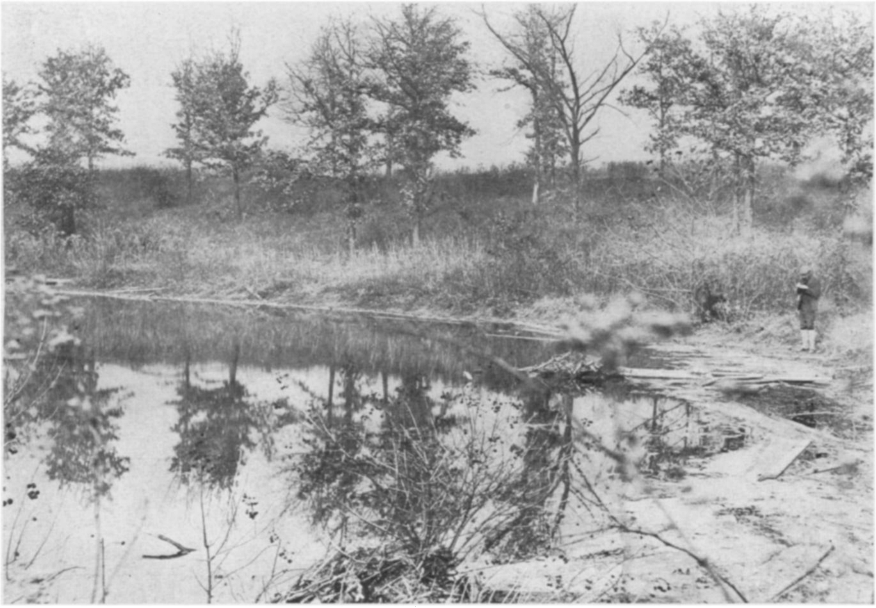
Plate 20.—*Nelumbium luteum* and *Polygonum Muhlenbergii* in Pittsburg Lake, St. Clair Co., Ill. The dead and dying trees are willows.

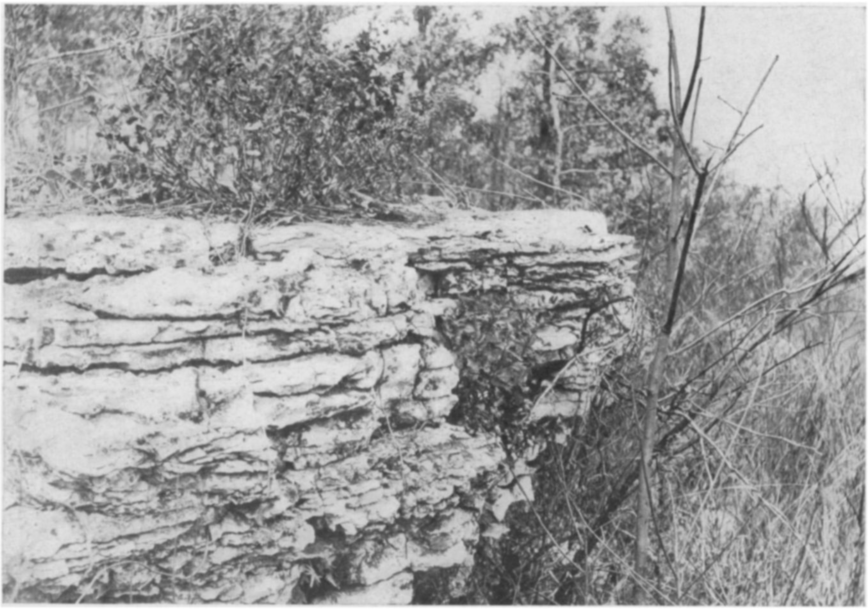


THE MISSOURI SHORE AT SELMA.

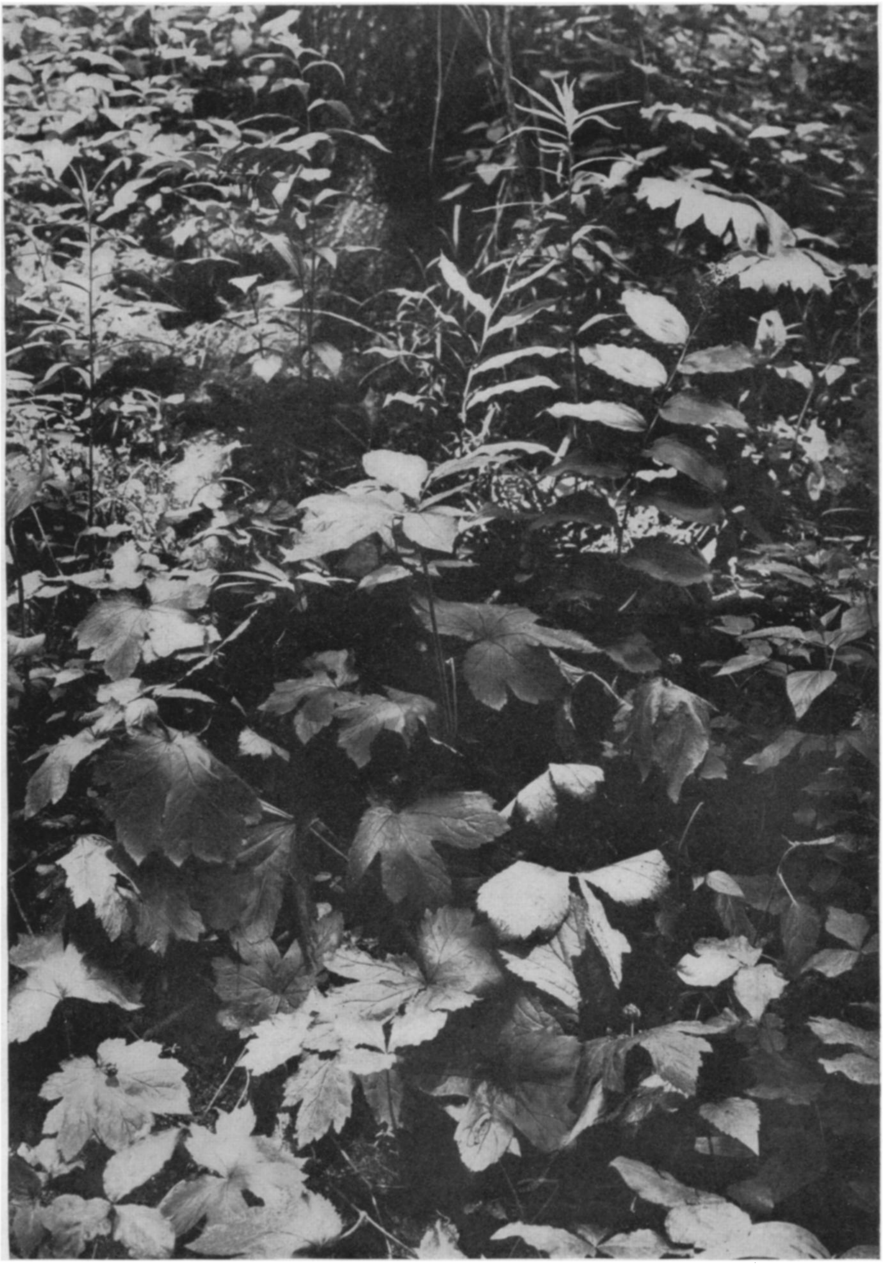


THE RIVER AT SELMA.

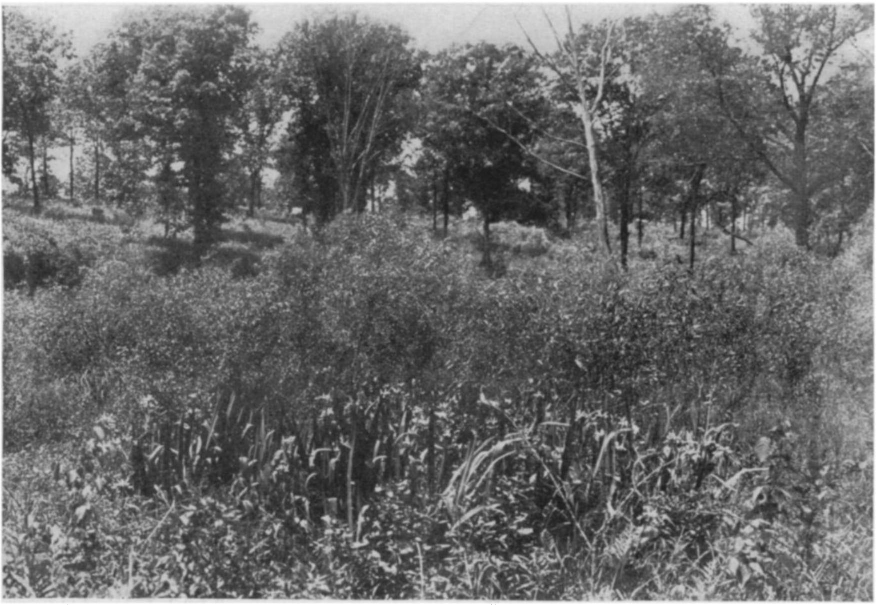


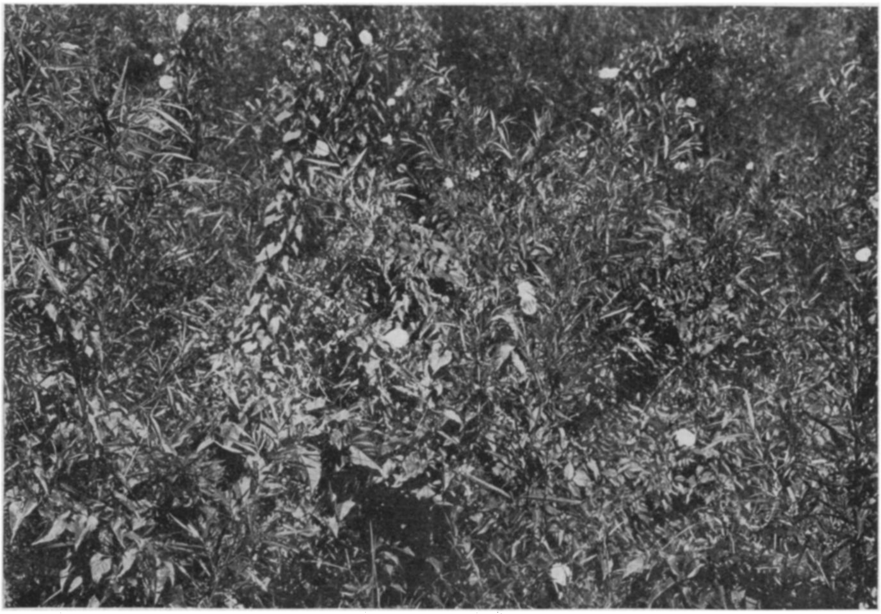


UPLAND POND AND BLUFF.

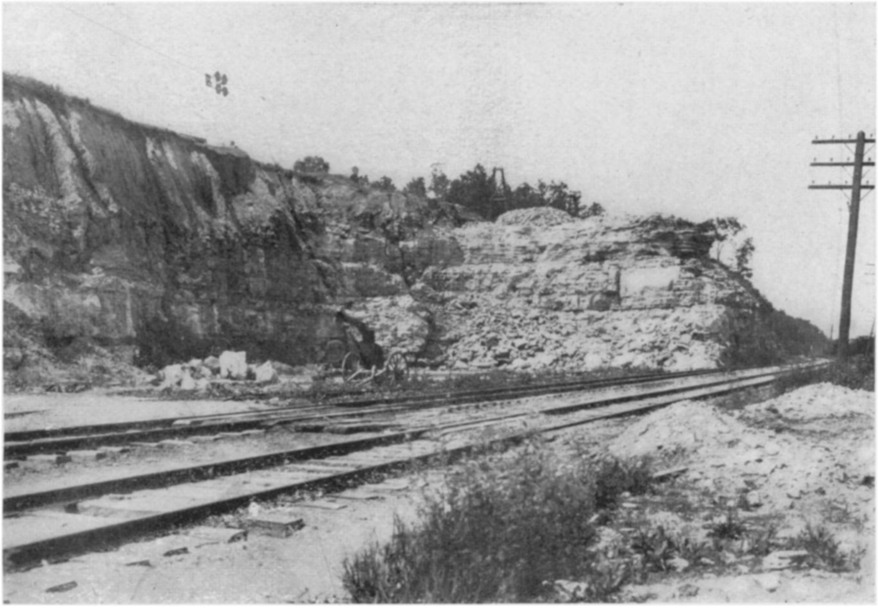


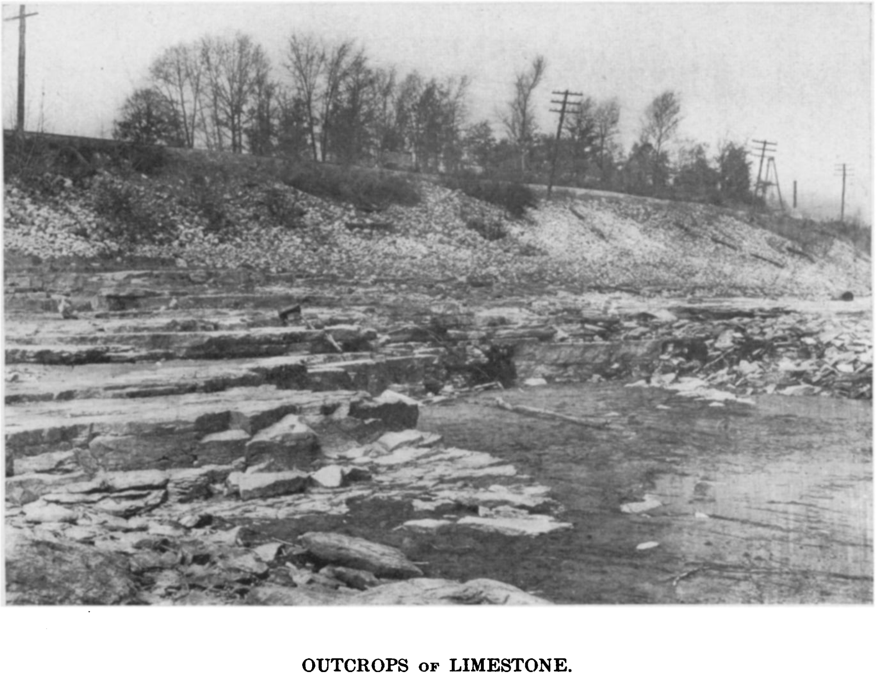
SINK-HOLE VEGETATION.



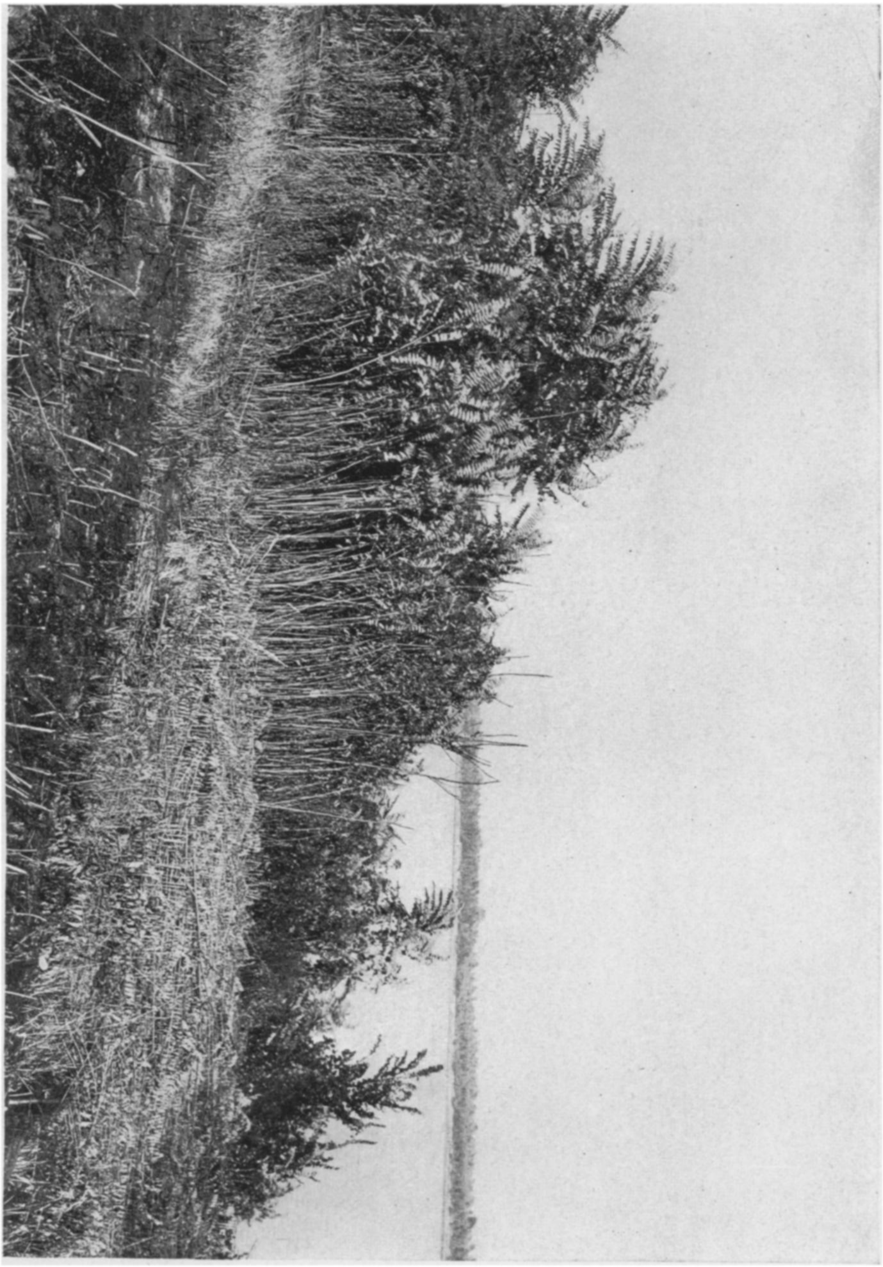


IRIS AND CONVOLVULUS.

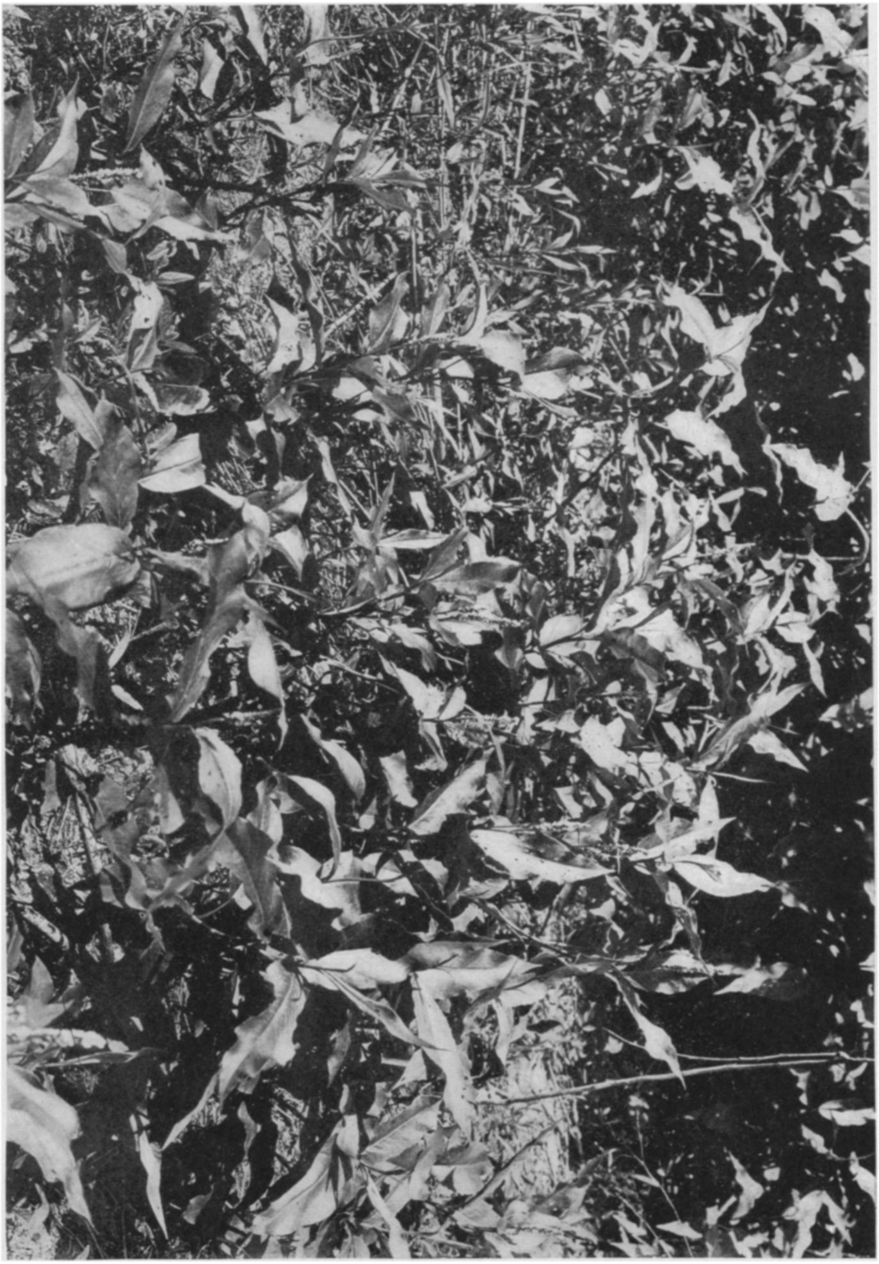




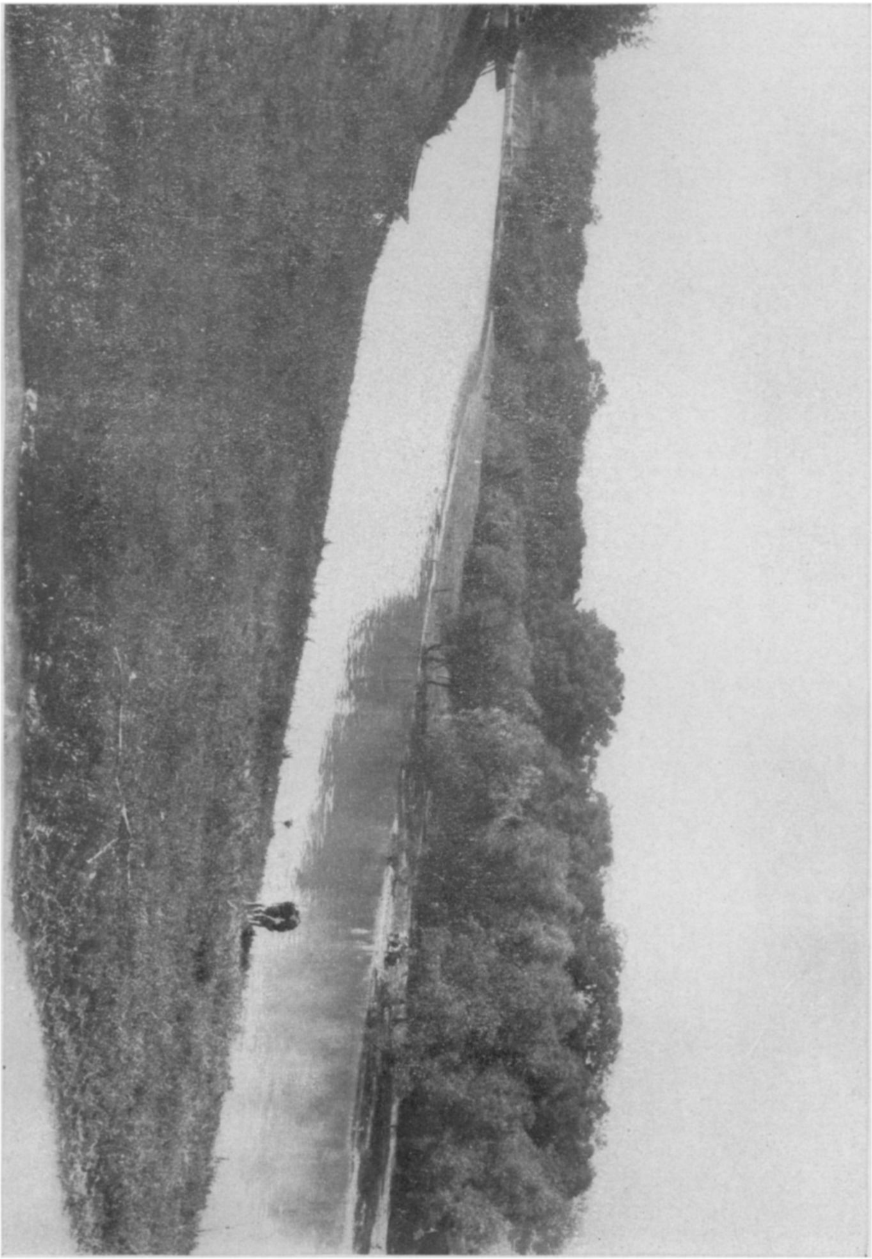
OUTCROPS OF LIMESTONE.



RHUS on RAILROAD EMBANKMENT.

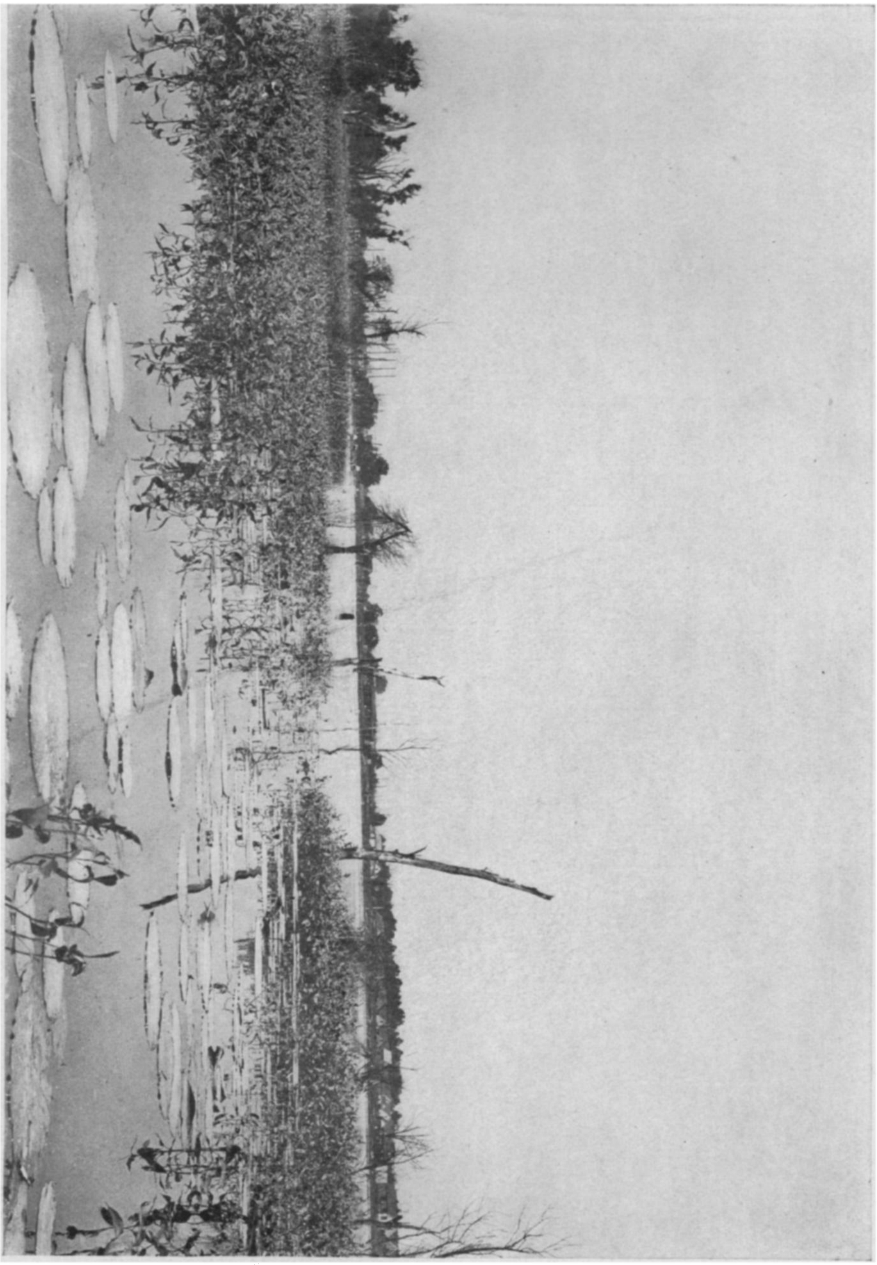


POLYGONUM in RIVER BOTTOM.



RIVER DES PÈRES.

BOTTOM FLORA, RIVER DES PERES.



LAKE FLORA, ILLINOIS BOTTOMS.